SERBIA MRS
Materials Research
Society of Serbia

Twenty-fourth Annual Conference

YUCOMAT 2023

Program and Book of Abstracts

endorsed by
FEMS
FEDERATION OF EUROPEAN
MATERIALS SOCIETIES

Materials Research Society of Serbia
24 conference
SERBIA MRS
YUCOMAT 2023
Herceg Novi, Montenegro : : September 4-8, 2023

TWENTY-FOURTH ANNUAL CONFERENCE

YUCOMAT 2023

Hunguest Hotel Sun Resort, Herceg Novi, Montenegro
September 4 - 8, 2023

Program
and
Book of Abstracts

Organised by
Materials Research Society of Serbia

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Federation of European Material Societies

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WELCOME SPEECH BY THE PRESIDENT OF MRS-SERBIA

Esteemed Colleagues, Fellow Scientists and Honored Guests,

It is my pleasure to greet you on behalf of MRS-Serbia and express a special joy that after 4 years we are now returning to the traditional system of holding the conference onsite, which used to be the standard format of YUCOMAT. The coronavirus pandemic had an effect similar to that of a devastating earthquake and the return to the previous habits will be, no doubt, gradual, while the consequences will be felt for a very long time.

The program of this year's conference includes 5 plenary sessions at which 19 invited lectures will be delivered; 4 oral sessions where 50 talks will be given; and 3 poster sessions where 102 works will be exhibited. Altogether with the lectures by the sponsors, 175 works by authors from 28 different countries will be presented. The general program, the relevance of the topics and the diversity of the institutions from which the presenters have arrived witness that we are still on an ascending path. The numbers of participants and speakers are similar to those from years prior to the pandemic, while the regional institutional representation is slowly becoming restored.

Never before did we have such a high-quality and diverse program and there are only a few conferences of this size in the world that can take pride in an equal number of high-ranked plenary speakers in terms of scientific influence measured through citations. Of the thirty highest-ranked authors from the lists that circulated in the recent years, 7 of them, that is, 25% in total, will speak at this year's YUCOMAT, and neither do other plenary speakers, according to these criteria, lag far behind them. A certain number of confirmed plenary speakers, who were announced earlier as participants, were unfortunately prevented from participating, but their invitation to present will extend to the next year’s conference, which will be the anniversary, 25thone, scheduled for September 2 – 6, 2024. Many members of our Society are responsible for this success, but my gratitude first and foremost goes to the plenary lecturers whose presence here has helped YUCOMAT reach the very summit of the world's scientific meetings, not by numbers of participants or by financial profit, but by excellence. We will, of course, strive to help YUCOMAT to grow even further in the years that follow.

This year's winner of the MRS-Serbia Award for the Lasting and Outstanding Contribution to Materials Science and Engineering is Mr. Knut W.Urban, a professor at Aachen University and the former Director of the Institute of Microstructure Research at Forschungszentrum Jülich (1987-2010) as well as the former President of the German Physical Society. He is the winner of many prior awards and recognitions, including the Kavli Award for the year 2020. Prof. Urban has been a long-time member of the International Advisory Board of MRS-Serbia and plenary speaker at many YUCOMAT conferences. He is a scientist with a large contribution to our field of study and also one who has contributed greatly to our affirmation as a reputable international conference. Prof. Urban is here and will present his lecture later in the day.

More than fifty young researchers from 18 countries will compete for the 11 awards given by our Society and by the MRS-Singapore for the best doctoral dissertations defended between the two conferences and for the best poster (Tuesday, 8.00-9.45) and the best oral presentation (Wednesday, 15.00-19.00). The winners will be announced at the Closing Ceremony on Friday, September 8 at

12:00 p.m. At today's opening of the conference, awards will be given to the last year's winners. So far, there have been more than 100 young researchers who have received these awards.

Following last year's charitable campaign, the European Office of Aerospace Research (EOARD), Drexel University and MRS-Serbia have ensured the participation of 43 researchers from Ukraine, covering the cost of their stay in Herceg Novi (EOARD and Drexel) and the conference fee (MRS-Serbia). Many of them come from outside Ukraine, including countries such as Lithuania, Latvia, Poland, Germany, Slovakia, Spain and Italy, where their colleagues and institutions of the European Union have showed hospitality and/or where they participate in joint research projects. We are pleased to be a part of this support that enables them to speak at YUCOMAT, socialize with the participants of the conferences, and at least for a little while forget about the tragic events in their country. Among other topics, they will present the project titled Towards MXenes Biomedical Application by High Dimensional Immune MAP-ing (HORIZON-MSCA-2021-SE-01 project MX-MAP), which proceeds with the participation of two Ukrainian institutions and nine institutions from the European Union. This presentation will be on Wednesday, September 6 at 3:00 p.m. in the small hall.

I spoke about the history of MRS-Serbia and YUCOMAT several times at previous conferences, but it will not hurt to repeat some remarks because of the new participants. First, there are much older, tidier and more touristy coastal towns than Herceg Novi, but there are very few of them that have attracted and inspired as many artists, writers and scientists to settle here as Herceg Novi did. We have been here since 1966, when the First Yugoslav-Soviet School of Powder Metallurgy and Ceramics was organized, where the majority of Soviet participants were affiliated with Ukrainian institutions. With the input from the scientists from the USA, Europe and the Far East, this School became the nucleus for the formation of the International Institute for the Science of Sintering (www.iiss-sci.org). The first IISS conference was held in 1969 in this hotel complex, in this hall, which at the time belonged to the Nuclear Commission of Yugoslavia, where as the first YUCOMAT Conference of our MRS (www.mrs-serbia.org.rs) was held in 1995, in a Herceg Novi hotel further down the shore. Many conferences were held here in that period of time and thousands of scientists from all over the world flocked to this city to experience its beauty. Moreover, it is not a coincidence that exactly on this part of the coast, lying between Herceg Novi and Igalo, called Topla (meaning "warm") because of its unique climatic conditions, many extraordinary scholars lived and worked. This includes our greatest poet and statesman, Petar II Petrović Njegoš (1813-1851), who was educated in a small house near the Church of St. George and Savior, which is a few minutes' walk from us. He always stressed his attachment to Boka and how that period of his life helped him soften his mountainous character with the authentic Boka's warmth. Further, there is a house not far from here, on the opposite side of the hotel, which was built by the 1961 Nobel Laureate in Literature, Ivo Andrić. He lived and worked in it, and it is now converted to a museum honoring his lifework. There are other wonderful attractions too, including the Old Town, the Forte Mare Fortress, the City Port Square, the City Tavern, the 5 Danica Promenade, and others. Our current hosts and owners of this hotel respect our tradition and attachment to the city and have helped us in our effort to make the conference participants feel comfortable here and to continue being part of this remarkable history. In that name, I wish you a pleasant stay, a wonderful conference, and may you return home satisfied, remember all of this and come back to us again.

MRS-President, Dragan P. Uskoković

2023 MRS-SERBIA AWARD FOR A LASTING AND OUTSTANDING CONTRIBUTION TO MATERIALS SCIENCE AND ENGINEERING

We are pleased to announce that the laureate of the **2023 MRS-Serbia Award for a Lasting and Outstanding Contribution to Materials Science and Engineering** is

Prof. Dr. Knut W. Urban

He is awarded for his achievements in materials science and especially in abberation correction which have revolutionized the field of electron microscopy of advanced materials and nanotechnology.

This is the decision of the MRS-Serbia Executive Board:

The Executive Board of the MRS- Serbia Presidency, at their online meeting on 15. 02. 2022, considered the submitted nomination for the MRS-Serbia's 2022 Award for a Lasting and Outstanding Contribution to Materials Science and Engineering. It is concluded that the procedure was conducted in accordance with the Awarding Rulebook, that the Call was announced on the MRS- Serbia's website on December 31st, 2021, and that in the stipulated period of 45 days two candidates were submitted:

- **Prof. Dr. Richard W. Siegel**
- **Prof. Dr. Knut W. Urban**

Having received the opinion from the Expert Committee members: Prof. Dr. Dragan Uskoković (President of MRS- Serbia), Prof. Yury Gogotsi (Chair of YUCOMAT Conferences International Advisory Board and as 2021 Laureate), Prof. Robert Sinclair (Honorary Chair of YUCOMAT Conferences International Advisory Board and as 2020 Laureate), Prof. Dejan Raković (Vice-President of MRS-Serbia), Dr. Slobodan Milonjić (President of the Council and Member of the Presidency of MRS-Serbia), Prof. Dr. Nenad Ignjatović (Member of the Presidency and Secretary General of MRS-Serbia) and Prof. Dr. Ivan Bozovic as 2015 Laureate, Prof. Dr. Gordana Vunjak-Novaković as 2016 Laureate, Prof. Dr. Velimir Radmilović as 2017 Laureate, Prof. Dr. László Forró as 2018 Laureate and Prof. Danilo Suvorov as 2019 Laureate, the Executive Board of the MRS-Serbia Presidency took the decision that Prof. Dr. Richard W. Siegel should be granted MRS-Serbia's 2022 Award for a Lasting and Outstanding Contribution to Materials Science and Engineering while Prof. Dr. Knut Urban should be Laureate of 2023 MRS-Serbia Award. Prof. Dr. Knut W. Urban was strongly supported by Prof. Dr. Dragan Uskoković, Dr. Slobodan Milonjic, Prof. Dr. Velimir Radmilović, Prof. Dejan Raković, Prof. Dr. Nenad Ignjatović, Prof. Dr. Đorđe Janaćković and Prof. Dr. Petar Uskoković.

Prof. Dr. Knut W. Urban's invited plenary lecture will be presented during the Opening Ceremony of the 24th MRS-Serbia Annual Conference YUCOMAT 2023, starting at 08.30 a.m. on Monday, September 4, 2023.

President of MRS-Serbia, Prof. Dr. Dragan Uskoković
Vice-President of MRS-Serbia, Prof. Dr. Velimir Radmilović
Vice-President of MRS-Serbia, Prof. Dr. Dejan Raković
General Secretary of MRS-Serbia, Prof. Dr. Nenad Ignjatović

MATERIALS RESEARCH SOCIETY OF SERBIA

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YUCOMAT 2023

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History

The First Conference on materials science and engineering, including physics, physical chemistry, condensed matter chemistry, and technology in general, was held in September 1995, in Herceg Novi. An initiative to establish Yugoslav Materials Research Society was born at the conference and, similar to other MR societies in the world, the programme was made, and objectives determined. The Yugoslav Materials Research Society (Yu-MRS), a non-government and non-profit scientific association, was founded in 1997 to promote multidisciplinary goal-oriented research in materials science and engineering. Main task and objective of the Society is to encourage creativity in materials research and engineering to reach a harmonic coordination between achievements in this field in our country and analogous activities in the world with an aim to include our country into the global international projects. Until 2003, Conferences were held every second year and then they grew into Annual Conferences that were traditionally held in Herceg Novi in September of every year. Following the political separation between Serbia and Montenegro, in 2007 Yu-MRS formed two new MRS: MRS-Serbia (official successor of Yu-MRS) and MRS-Montenegro (in founding). In 2008 MRS-Serbia became a member of FEMS (Federation of European Materials Societies).

General information

DATE AND VENUE: The conference will be held on September 4-8, 2023, at the Hunguest Hotel Sun Resort, in Herceg Novi, Montenegro. Participants will also be accommodated there. The conference will begin on Monday, September 4th, at 08.30 and end on Friday, September 8th, 2023, at 12.30.

REGISTRATION: Registration, registration fee payment, conference materials distribution, etc, will take place at the conference desk (Conference Secretariat) open on Sunday, September 3rd, and Monday, September 4th, from 7.30 to 19.00, on Tuesday, Wednesday and Thursday 07.30-12.00 and 19.00-20.00, and on Friday from 07.30 to 12.00. At registration, the participants are requested to submit a proof of their advance registration fee payment.

INSTRUCTION FOR AUTHORS: The conference will feature Plenary Sessions, Oral Sessions, and Poster Sessions. Time of papers' presentations to be given in Oral Sessions is limited. Time available for delivery is 40 min for plenary and 15 min for other papers, including discussion. Video-beam is available. PowerPoint presentations, recorded on CD or USB flash- memory, should be given at the start of the session. In Poster Sessions, the authors are requested to display their posters minimum one hour before the session and to be present beside their posters during the session. The poster sessions' venue will be open from Tuesday to Thursday.

CONFERENCE AWARDS: Joint Award by MRS-Singapore and MRS-Serbia at the YUCOMAT 2023 Conference. Sponsorship of the ten Awards in the financial amount by the MRS-Singapore, to the authors not older than 35 for the best: Five Oral presentation, Five Posters presentation, and one PhD Thesis. Awarded authors will be announced at the Closing Ceremony of the Conference. Each award consists of a financial amount honorarium, diploma, meeting registration fee to attend the next YUCOMAT 2024 Conference, and a one-year MRS Serbia membership.

ADDITIONAL ACTIVITIES: Traditional Cocktail Party on Monday evening and excursion on Thursday afternoon (boat trip around Boka Kotorska Bay) will be organized again.

GENERAL YUCOMAT 2023 CONFERENCE PROGRAM

Sunday, September 3, 2023

07.30-19.00	**Registration**

Monday, September 4, 2023

07.30-19.00	**Registration**
08.30-09.00	**OPENING CEREMONY and Awards,** Main Conference Hall Welcome Speech - **Dragan Uskoković**, president of MRS-Serbia Welcome Address **- Yury Gogotsi**, Chair of the International Advisory Board **Presentation of the YUCOMAT 2022 Awards** for young authors of the best PhD thesis, best oral and best poster presentation
09.00-09.45	The Laureate of the 2023 MRS-Serbia, Award for a Lasting and Outstanding Contribution to Materials Science and Engineering, **Knut W. Urban**
10.15-12.55	**First Plenary Session**, Main Conference Hall
13.15	**Photo Session**
15.00-18.30	**Second Plenary Session**, Main Conference Hall
20.00-22.00	**Cocktail Party**

Tuesday, September 5, 2023

08.00-09.45	**First Poster Session,** National Restaurant Jadranka Terrace **Competition for the best poster presentation by young researchers**
10.00-12.00	**Third Plenary Session,** Main Conference Hall
15.00-18.15	**Fourth Plenary Session,** Main Conference Hall

Wednesday, September 6, 2023

08.00-09.45	**Second Poster Session**, National Restaurant Jadranka Terrace
10.00-13.00	**Fifth Plenary Session**, Main Conference Hall
15.00-18.30	**First Oral Session, Competition for the best oral presentation,** Main Conference Hall
15.00-17.30	**MX-MAP Session,** Small Conference Hall

Thursday, September 7, 2023

08.00-09.45	**Third Poster Session**, National Restaurant Jadranka Terrace
10.00-12.45	**Second Oral Session,** Main Conference Hall
14.00	**Boat-trip around Boka Kotorska Bay**

Friday, September 8, 2023

08.30-11.45	**Third Oral Session**, Main Conference Hall
12.00	**Closing Ceremony - YUCOMAT 2023 Award Grants for Young Researchers**
12.30	**Farewell Cocktail**

SCIENTIFIC PROGRAM

Sunday, September 3, 2023

07.30– 19.00 Registration

Monday, September 4, 2023

OPENING CEREMONY, Main Conference Hall

08.30-09.00 Welcome Speech-**Dragan Uskoković**, president of MRS-Serbia,
Welcome Address -**Yury Gogotsi**, Chair of the International Advisory Board
Presentation of YUCOMAT 2022 Awards for young authors with the best PhD thesis, oral and poster presentations

09.00-09.45 **MRS-Serbia 2023 Award for a Lasting and Outstanding Contribution to Materials Science and Engineering**
Knut W. Urban, *Ernst Ruska Center for Microscopy and Spectroscopy with Electrons, Research CenterJülich, RWTH-Aachen University, Jülich, Germany*
A short history of aberration-corrected electron optics and the realization of atomic-resolution electron microscopy

09.45-10.15 **Break**

FIRST PLENARY SESSION, Main Conference Hall

10.15 -12.55
Chairpersons: Lei Jiang, Markus Antonietti

10.15-10.55 **PL.S.1.**
High-throughput materials discovery with nanomaterial megalibraries
Chad A. Mirkin, *Northwestern University, Evanston, Illinois, USA*

10.55-11.35 **PL.S.2.**
Super-wettability and beyond quantum-confined superfluid: biological energy conversion, chemical reaction and information transfer
Lei Jiang, *Technical Institute of Physics and Chemistry, Chinese Academy of Sciences, Beijing, P. R. China China*

11.35-12.15 **PL.S.3.**
Understanding and controlling charge, heat, and spin at atomically precise interfaces
Paul S. Weiss, *California NanoSystems Institute and Departments of Chemistry & Biochemistry, Bioengineering, and Materials Science & Engineering, University of California, Los Angeles (UCLA), Los Angeles, USA*

12.15-12.55 **PL.S.4.**
New modifications of carbon nitrides and their use in artificial photosynthesis and single atom support
Markus Antonietti, *Max Planck Institute of Colloids and Interfaces, Potsdam, Germany*

13.15 **Photo session**

13.30-15.00 **Break**

SECOND PLENARY SESSION Main Conference Hall

15.00-18.30
Chairpersons: John A. Rogers, Dongyuan Zhao

15.00-15.40 **PL.S.5.**
TENG - from scientific discoveries to technological innovations
Zhong Lin Wang, *Beijing Institute of Nanoenergy and Nanosystems, Beijing, P. R. China and Georgia Institute of Technology, Atlanta, Georgia, USA*

15.40-16.20 **PL.S.6.**
Materials for 3D functional mesosystems: from neural interfaces to environmental monitors
John A. Rogers, *Northwestern University, Evanston, IL, USA*

16.20-16.40 **Break**

16.40-17.20 **PL.S.7.**
Oriented assembly of functional mesoporous materials with multi-level architectures
Dongyuan Zhao, *Department of Chemistry, Fudan University, Shanghai, P. R. China*

17.20-18.00 **PL.S.8.**
Cobalt-free oxide cathodes for high energy density lithium batteries
Arumugam Manthiram, *Department of Mechanical Engineering, The University of Texas at Austin, USA*

18.00-18.15 **Sponsor Presentation**
Air force office of scientific research grant funding opportunities
David Swanson, *U.S. Air Force Office of Scientific Research, European Office of Aerospace Research and Development, London, United Kingdom*

18.15-18.**30** **Sponsor Presentation**
Research interests of the army research office's science of extreme materials branch
Evan Runnerstrom, *US Army Research Laboratory, USA*

20.00 **Cocktail Party**

Tuesday, September 5, 2023

First Poster Session, National Restaurant Jadranka Terrace
Competition for the best poster presentation by young researchers

08.00-09.45
Chairpersons: Zoran Jovanović, Vuk Radmilović

YUCOMAT SYMPOSIUM A:
ADVANCED METHODS IN SYNTHESIS AND PROCESSING OF MATERIALS

P.S.1.
Influence of metal selection and catalyst pretreatment on the aldaric acid dehydroxylation process
Brigita Hočevar[1], Anže Prašnikar[1], Florian Maximilian Harth[1], Matej Huš[1], Miha Grilc[1], Sašo Gyergyek[2], Blaž Likozar[1]
[1]National Institute of Chemistry, Ljubljana, Slovenia, [2]Jozef Stefan Institute, Ljubljana, Slovenia

P.S.2.
Microsecond range pulsed DC plasma electrolytic oxidation on Ti and Nb
Kristina Mojsilović, Jovica Jovović, Stevan Stojadinović, Rastko Vasilić
Faculty of Physics, University of Belgrade, Belgrade 11000, Serbia

P.S.3.
Basalt-based glass-ceramic composites
Aleksa Luković, Vladimir Pavkov, Branko Matović, Emilija Nidžović, Marija Prekajski-Đorđević, Jelena Maletaškić
Vinča Institute of Nuclear Sciences, National Institute of the Republic of Serbia, University of Belgrade, Belgrade, Serbia

P.S.4.
High-speed sintering of submicron-grained WC-8Co hardmetals
Ievgen Solodkyi[1,2], Sergii Teslia[1], Oleksandr Kucher[1], Iurii Bogomol[1], Petro Loboda[1]
[1]Igor Sikorsky Kyiv Polytechnic Institute, Kyiv, Ukraine, [2]Otto von Guericke University Magdeburg, Germany

P.S.5.
Effect of laser powder bed fusion process parameters on the static recrystallization temperature of Inconel 625 superalloy
Hubert Pasiowiec, Beata Dubiel
AGH University of Science and Technology, Faculty of Metals Engineering and Industrial Computer Science, Kraków, Poland

YUCOMAT SYMPOSIUM B:
ADVANCED MATERIALS FOR HIGH-TECHNOLOGY APPLICATION

P.S.6.

Hydrothermally activated vine shoots for carbon-based aqueous supercapacitors

Minea Kapidžić[1], Jana Mišurović[1], Milica Vujković[2], Veselinka Grudić[1]
[1]*University of Montenegro, Faculty of Metallurgy and Technology, Podgorica, Montenegro,*
[2]*University of Belgrade, Faculty of Physical Chemistry, Belgrade, Serbia*

P.S.7.

MXenes based surface enhanced Raman spectroscopy sensor for the detection of drug metabolites

Simonas Ramanavicius[1], Anton Popov[2], Sonata Adomaviciute-Grabusove[3], Martynas Talaikis[1], Valdas Sablinskas[3], Arunas Ramanavicius[4], Gediminas Niaura[1]
[1]*Department of Organic Chemistry, State Research Institute Center for Physical Sciences and Technology (FTMC), Lithuania,* [2]*NanoTechnas—Center of Nanotechnology and Materials Science, Faculty of Chemistry and Geosciences, Vilnius University, Lithuania,* [3]*Institute of Chemical Physics, Vilnius University, Lithuania,* [4]*Department of Physical Chemistry, Faculty of Chemistry and Geosciences, Institute of Chemistry, Vilnius University, Lithuania*

P.S.8.

ZnO/RuO_2 nanostructured composites with enhanced bifunctional photo-electro catalytic activity toward water splitting

Katarina Aleksić[1], Ivana Stojković Simatović[2], Smilja Marković[1]
[1]*Institute of Technical Sciences of SASA, Belgrade/Serbia,* [2]*University of Belgrade, Faculty of Physical Chemistry, Belgrade, Serbia*

P.S.9.

Intrinsic point defects in $BaTiO_3$-based ceramics

Vojtech Marak[1], Daniel Drdlik[1,2], Pavel Tofel[1,3], Martin Kachlik[1], Vinicius Santana[1], Karel Maca[1,2]
[1]*CEITEC BUT, Brno University of Technology, Brno, Czech Republic,* [2]*Faculty of Mechanical Engineering, Brno University of Technology, Brno, Czech Republic,* [3]*Faculty of Electrical Engineering and Communication, Brno University of Technology, Brno, Czech Republic*

P.S.10.

Potential of applying the quadratic failure criteria for short carbon fibre-reinforced PET-G composite material used in additive manufacturing

Milan Janković[1], Ana Petrović[1], Vesna Lojpur[2], Marko Miloš[1], Igor Balać[1]
[1]*Faculty of Mechanical Engineering, University of Belgrade, Serbia,* [2]*Vinča Institute of Nuclear Sciences, National Institute of the Republic of Serbia, University of Belgrade, Serbia*

P.S.11.

Olive mill waste towards carbon electrodes for aqueous supercapacitors

Sonja Kastratović[1], Minea Kapidžić[1], Danilo Marković[1], Veselinka Grudić[1], Milica Vujković[2], Jana Mišurović[1]
[1]*University of Montenegro, Faculty of Metallurgy and Technology, Podgorica, Montenegro,*
[2]*University of Belgrade, Faculty of Physical Chemistry, Belgrade, Serbia*

P.S.12.

Novel synthetic approach of $NaCrO_2$ as a cathode material for aqueous sodium ion battery

Danilo Marković[1], Jana Mišurović[1], Veselinka Grudić[1], Milica Vujković[2]
[1]*University of Montenegro, Faculty of Metallurgy and Technology, Podgorica, Montenegro,*
[2]*University of Belgrade, Faculty of Physical Chemistry, Belgrade, Serbia*

YUCOMAT SYMPOSIUM C: **NANOSTRUCTURED MATERIALS**

P.S.13.

Consolidation of strontium hexaferrite sintering by pressureless spark plasma sintering (PSPS)

Aleksander Učakar[1,2,3], Andraž Kocjan[2,3], Petra Jenuš[2,3]
[1]*Center for Microscopy and Microanalysis, Jožef Stefan Institute, Ljubljana, Slovenia,*
[2]*Department for Nanostructured Materials, Jožef Stefan Institute, Ljubljana, Slovenia,*
[3]*Jožef Stefan International Postgraduate School, Ljubljana, Slovenia*

P.S.14.

Structure and magnetodielectric properties of hybrid ferrite-based nanoparticles

Agnieszka Ciuraszkiewicz[1], Dariusz Łukowiec[2], Łukasz Hawełek[1], Adrian Radoń[1]
[1]*Łukasiewicz Research Network, Institute of Non-Ferrous Metals, Gliwice, Poland,*
[2]*Silesian University of Technology, Gliwice, Poland*

P.S.15.

Evolution of crystal structure and magnetic properties with heat treatment rapidly quenched $Fe_{77.3}Co_5Nb_3Cu_{0.7}B_{14}$ ribbon

Tymon Warski[1,2], Przemysław Zackiewicz[1], Anna Wójcik[3], AleksandraKolano-Burian[1], Jon Gutiérrez Etxebarria[4], Inaki Orue[4], Łukasz Hawełek[1]
[1]*Łukasiewicz Research Network, Institute of Non-Ferrous Metals, Gliwice, Poland,* [2]*Silesian University of Technology, Gliwice, Poland,* [3]*Institute of Metallurgy and Materials Science Polish Academy of Sciences, Krakow, Poland,* [4]*University of the Basque Country UPV/EHU, Bilbao, Spain*

P.S.16.

Effect of storage on electrical properties of MXene films deposited from N-methyl-2-pyrrolidone

Oksana Gutsul[1,2], Egor Ukraintsev[2], Katerina Aubrechtova Dragounova[3], Kezia Sasitharan[2], Vsevolod Slobodyan[4], Alexander Kromka[3], Bohuslav Rezek[2]
[1]*Bukovinian State Medical University, Chernivtsi, Ukraine,* [2]*Czech Technical University, Prague, Czech Republic,* [3]*Institute of Physics of the Czech Academy of Sciences, Prague, Czech Republic,* [4]*Yury Fedkovich Chernivtsi National University, Chernivtsi, Ukraine*

P.S.17.

Solar-driven removal of 17α-ethynilestradiol from aqueous environment using green ZnO nanoparticles

Sabolč Bognar, Dušica Jovanović, Vesna Despotović, Nina Finčur, Daniela Šojić Merkulov
University of Novi Sad Faculty of Sciences, Department of Chemistry, Biochemistry and Environmental Protection, Novi Sad, Serbia

P.S.18.

Distance dependence of interaction of TDBC and TCC J-aggregates in layered polymer films

Polina Pisklova[1,2], Iryna Ropakova[1], Svetlana Yefimova[1], Stefan Lochbrunner[2], Oleksandr Sorokin[1]
[1]Institute for Scintillation Materials of NAS of Ukraine, Kharkiv, Ukraine, [2]Institute for Physics, University of Rostock, Rostock, Germany

P.S.19.

Structure and electrochemical hydrogenation properties of Ni/NiCo/Co powders obtained by femtosecond laser pulses

Oleksandr Kuznetsov[1,2], Iaroslav Gnilitskyi[1,2], Yuriy Verbovytskyy[3], Khrystyna Vlad[3], Vanessa Barvinska[1,2], Ihor Zavaliy[3]
[1]NoviNano Lab LLC, Ukraine, [2]Lviv Polytechnic National University, Ukraine, [3]Karpenko Physico-Mechanical Institute of the NAS of Ukraine

P.S.20.

Superhydrophilic properties caused by femtosecond laser nanostructuring on the Si surface

Vanessa Barvinska, Iaroslav Gnilitskyi
NoviNano Lab LLC, 79000, Lviv, Ukrain and Department of Applied Physics and Nanomaterials Science, Lviv Polytechnic National University, 79013, Lviv, Ukraine

P.S.21.

The effect of swift heavy ion irradiation on physicochemical properties of monoclinic bismuth vanadate

Marko Jelić[1], Ekaterina Korneeva[2], Nikita Kirilkin[2], Tatiana Vershinina[2], Oleg Orelovich[2], Vladimir Skuratov[2], Zoran Jovanović[1], Sonja Jovanović[1]
[1]Vinča Institute of Nuclear Sciences, National Institute of the Republic of Serbia, University of Belgrade, Belgrade, Serbia, [2]Joint Institute for Nuclear Research, Dubna, Russia

P.S.22.

Synthesis and characterization of NiFe layered double hydroxides with different Ni^{2+}/Fe^{3+} molar ratios as multi-functional adsorptive materials

Tetiana Hubetska, Victor Demchenko, Natalia Kobylinska
A. V. Dymansky Institute of Colloid and Water Chemistry NAS of Ukraine, Kyiv, Ukraine

YUCOMAT SYMPOSIUM D: **ECO-MATERIALS AND ECO-TECHNOLOGIES**

P.S.23.

Removal of toxic dye by eco-friendly biochar derived from sour cherry stone

Anja Antanasković[1], Zorica Lopičić[1], Vladimir Adamović[1], Tatjana Šoštarić[1], Danijela Smiljanić[1], Milan Milivojević[2]
[1]Institute for Technology of Nuclear and Other Mineral Raw Materials, Belgrade, Serbia, [2]Faculty of Technology and Metallurgy, University of Belgrade, Serbia

P.S.24.

Recycling of flat glass for glass foam production

Veljko Savić[1], Vladimir Topalović[1], Jelena Nikolić[1], Marija Đošić[1], Srđan Matijašević[1], Snežana Grujić[2]
[1]Institute for Technology of Nuclear and Other Mineral Raw Materials, Belgrade, Serbia, [2]University of Belgrade, Faculty of Technology and Metallurgy, Belgrade, Serbia

P.S.25.

The effect of NaCl and SLES on recycled mixture HIPS and ABS contact angles

Benita Malinowska[1,2], Julio León Munoz Esteban[3], Evgeniy Pakhlov[2,4], Konrad Terpiłowski[2]
[1]Polska Korporacja Recyklingu, [2]Maria Curie-Sklodowska University, Department of Interfacial Phenomena, [3]Erasmus Programme, [4]Institute of Surface Chemistry of National Academy of Sciences of Ukraine, Kyiv, Ukraine

YUCOMAT SYMPOSIUM E: **BIOMATERIALS**

P.S.26.

Novel MXene-anti-CEACAM1 complex for melanoma targeted treatment

Anastasia Konieva[1,2], Irina Kube-Golovin[2], Mykola Lyndyn[1,2], Oleksiy Gogotsi[3], Ivan Baginskiy[3], Veronica Zahorodna[3], Oksana Pogorielova[1], Iryna Roslyk[3], Igor Iatsunskyi[4], Maksym Pogorielov[1,5], Gunther Wennemuth[2]
[1]Sumy State University, Sumy, Ukraine, [2]Department of Anatomy, University Clinic Essen, Essen, Germany, [3]Materials Research Centre LTD, Kyiv, Ukraine, [4]NanoBioMedical Centre, Adam Mickiewicz University, Poznan, Poland, [5]University of Latvia, Riga, Latvia

P.S.27.

Antibacterial copper nanoparticles loaded pH-responsive nanocapsules for the treatment of infectious wounds

Veronika Poláková, Zdenka Fohlerová, Lucy Vojtová
CEITEC BUT, Central European Institute of Technology, Advanced biomaterials, Brno University of Technology

P.S.28.

The influence of calcification on the microelement composition in the dura mater

Anastasiia Denysenko, Roman Moskalenko
Department of Pathology, Sumy State University, Sumy, Ukraine

P.S.29.

Induction of the DNA comets by $T_3C_2T_x$ MXene is not an artefact of the DNA comet assay

Zhanna Klishchova[1], Inna Chorna[1], Anton Roshchupkin[1], Ilya Yanko[1], Ivan Baginskiy[2], Veronika Zahorodna[2], Iryna Roslyk[2], Oleksiy Gogotsi[2], Maksym Pogorielov[1,3], Sergiy Kyrylenko[1]
[1]Sumy State University, Sumy, Ukraine; [2]Materials Research Centre LTD, Kyiv, Ukraine; [3]University of Latvia, Riga, Latvia

P.S.30.

Genotoxicity of $T_3C_2T_x$ MXene revealed by the DNA comet assay depends on the size of the MXene flakes

Inna Chorna[1], Zhanna Klishchova[1], Anton Roshchupkin[1], Ilya Yanko[1], Ivan Baginskiy[2], Veronika Zahorodna[2], Iryna Roslyk[2], Oleksiy Gogotsi[2], Maksym Pogorielov[1,3], Sergiy Kyrylenko[1]
[1]Sumy State University, Sumy, Ukraine, [2]Materials Research Centre LTD, Kyiv, Ukraine, [3]University of Latvia, Riga, Latvia

P.S.31.

Genotoxicity of $T_3C_2T_x$ MXene depends on the size of the MXene flakes

Inna Chorna[1], Zhanna Klishchova[1], Milena Yalyzhko[1], Anton Roshchupkin[1], Ilya Yanko[1], Ivan Baginskiy[2], Veronika Zahorodna[2], Iryna Roslyk[2], Oleksiy Gogotsi[2], Maksym Pogorielov[1,3], Sergiy Kyrylenko[1]
[1]Sumy State University, Sumy, Ukraine, [2]Materials Research Centre LTD, Kyiv, Ukraine, [3]University of Latvia, Riga, Latvia

P.S.32.

MXene-based cardiac patches for regenerative medicine

Kateryna Diedkova[1,2], Ilya Yanko[1], Viktoriia Korniienko[1,2], Una Riekstina[2], Ivan Baginskiy[3], Vernika Zahorodna[3], Iryna Roslyk[3], Oleksiy Gogotsi[3], Maksym Pogorielov[1,2]
[1]Sumy State University, Sumy, Ukraine, [2]University of Latvia, Riga, Latvia, [3]Materials Research Center LTD, Kyiv, Ukraine

P.S.33.

Diffusion-controlled formation of fluorapatite-hydrogel composite for dental implant materials

Jimin Jung, Sung Ho Yang
Department of Chemistry Education, Korea National University of Education, Chungbuk, Korea

P.S.34.

Synthesis of ZnO-Au nanohybrids electrochemical imunosensors for L. Monocytogenes detection

Nataliya Babayevska[1], Igor Iatsunskyi[1], Anna Yanovska[2], Maksym Pogorielov[2,3]
[1]NanoBioMedical Centre, Adam Mickiewicz University, Poznan, Poland, [2]Sumy State University, Sumy, Ukraine, [3]Institute of Atomic Physics and Spectroscopy, University of Latvia, Riga, Latvia

P.S.35.

Physically crosslinked poly(methacrylic acid)/gelatin hydrogels

Vukašin Ugrinović[1], Maja Marković[1], Vesna Panić[1], Đorđe Veljovic[2]
[1]Innovation Center of Faculty of Technology and Metallurgy, Belgrade, Serbia, [2]Faculty of Technology and Metallurgy, University of Belgrade, Belgrade, Serbia

P.S.36.

3D printed bone scaffolds coated with bioactive proteins for regenerative medicine

Dávid Izsák, Veronika Pavliňáková, Klára Lysáková, Přemysl Menčík, Zuzana Kadlecová, Lucy Vojtová
CEITEC BUT, Central European Institute of Technology, Advanced biomaterials, Brno University of Technology, Brno, Czech Republic

P.S.37.

Preparation of Liposome-enriched system for controlled release of calendula officinalis extract in DFU treatment

Zuzana Kadlecová[1], Matěj Rychetský[2], Eva Vítová[2], Lucy Vojtová[1]
[1]Central European Research Institute, Brno University of Technology, Brno, Czech Republic, [2]Faculty of Chemistry, Brno University of Technology, Brno, Czech Republic

09.45-10.00 **Break**

THIRD PLENARY SESSION Main Conference Hall

10.00-12.00
Chairpersons: Vladimir P. Torchilin, Samuel I. Stupp

10.00-10.40 **PL.S.9.**

Frontiers in supramolecular design of materials

Samuel I. Stupp, *Departments of Materials Science and Engineering, Chemistry, Medicine, and Biomedical Engineering Simpson Querrey Institute for BioNanotechnology, Center for Bio-Inspired Energy Science, Northwestern University, Evanston, IL, USA*

10.40-11.20 **PL.S.10.**

Neutrophil extracellular traps (NETs) – novel target for drug delivery to various pathological sites

Vladimir P. Torchilin, *Center of Pharmaceutical Biotechnology and Nanomedicine, Department of Pharmaceutical Sciences, Northeastern University, Boston, USA*

11.20-12.00 **PL.S.11.**

Nano- and micro-structured biosensors on stiff and flexible substrates for implantable and wearable biomarker sensing

Anne Milasincic Andrews, *Departments of Chemistry & Biochemistry and Psychiatry & Biobehavioral Health, Semel Institute for Neuroscience and Human Behavior, Hatos Center for Neuropharmacology, and California NanoSystems Institute, University of California, Los Angeles, USA*

12.00-15.00 **Break**

FOURTH PLENARY SESSION Main Conference Hall

15.00-18.15
Chairpersons: Yury Gogotsi, Prashant Kamat

15.00-15.40 **PL.S.12.**
Transforming next generation photovoltaics with semiconductor nanostructures
Prashant V. Kamat, *Radiation Laboratory, Department of Chemistry & Biochemistry, University of Notre Dame, Notre Dame, South Bend, Indiana, USA*

15.40-16.20 **PL.S.13.**
Perovskite nanocrystals in light emitting devices
Andrey L. Rogach, *Department of Materials Science and Engineering, and Centre for Functional Photonics, City University of Hong Kong, Hong Kong SAR, China*

16.20-16.40 **Break**

16.40-17.20 **PL.S.14.**
MXenes across the electromagnetic spectrum – from UV to microwaves
Yury Gogotsi, *A. J. Drexel Nanomaterials Institute and Department of Materials Science and Engineering, Drexel University, Philadelphia, USA*

17.20-18.00 **PL.S.15.**
Facetted chemistry of earth-abundant nanostructured materials
Aleksandra Vojvodić, *Department of Chemical & Biomolecular Engineering, University of Pennsylvania, Philadelphia, USA*

18.00-18.15 **Sponsor Presentation**
Gain the maximum throughput with artifact-free surfaces for sample characterization by using high current plasma FIB-SEM
Martin Sláma, *Product Manager, Tescan Orsay Holding, a.s.*

Wednesday, September 6, 2023

Second Poster Session, National Restaurant Jadranka Terrace

08.00-09.45
Chairperson: Đorđe Veljović, Branko Matović

YUCOMAT SYMPOSIUM A:
ADVANCED METHODS IN SYNTHESIS AND PROCESSING OF MATERIALS

P.S.38.

The application of a ball-milled Fe-CuSn-Ni powder mixture to fabricate sintered diamond tools

Borowiecka-Jamrozek Joanna, Lachowski Jan
Kielce University of Technology, Kielce, Poland

P.S.39.

Physico-mechanical properties of powder coatings using residues of industrial wastewater treatment

Gennadii Kochetov[1], Dmytro Samchenko[1], Tetiana Prikhna[2], Oles Lastivka[1], Dmitro Derecha[3]
[1]Kyiv National University of Construction and Architecture, Ukraine,[2]V. Bakul Institute for Superhard Materials, Kyiv, Ukraine, [3]Institute of Magnetism, Kyiv, Ukraine

P.S.40.

Synthesis and characterization of Ni(III) complex with condensation product of 2-acetylpyridine and Girard's P reagent

Milica Savić[1], Mima Jevtović[2], Matija Zlatar[1], Maja Gruden[3], Dragana Mitić[2], Božidar Čobeljić[3], Katarina Anđelković[3]
[1]University of Belgrade - ICTM, Department of Chemistry, Belgrade, Serbia, [2]Innovative Centre of Faculty of Chemistry, Belgrade, Serbia, [3]University of Belgrade, Faculty of Chemistry, Belgrade, Serbia

P.S.41.

Optimisation, prototyping and production of metallic catalyst supports from $CuNi_2SiCr$ by selective laser melting technology

Bartosz Jóźwik[1,3], Marcin Polak[1], Adrian Radoń[1,2], Santina Topolska[2], Wojciech Łoński[2]
[1]Łukasiewicz Research Network, Institute of Non-Ferrous Metals, Gliwice, Poland, [2]Faculty of Mechanical Engineering, Silesian University of Technology, Gliwice, Poland, [3]Doctoral School, Silesian University of Technology, Gliwice, Poland

P.S.42.

A study of long-term oxidation resistance and its mechanism in films based on CrN deposited on stainless steel

Viktoriya Podhurska[1], Jaroslav Milewski[2], Olexander Kuprin[3], Pavel Shuhayeu[2]
[1]Karpenko Physico-Mechanical Institute of the NAS of Ukraine, Lviv, Ukraine, [2]Warsaw University of Technology, Warsaw, Poland, [3]National Science Center "Kharkiv Institute of Physics and Technology" of NASU, Kharkiv, Ukraine

P.S.43

Gas-detonation surface modification for dental implants

Volodymyr Deineka[1,2], Bogdan Drygval[2], Oksana Pogorielova[2], Maksym Pogorielov[1,2], Oleg Mishchenko[3]
[1]University of Latvia, Riga, Latvia, [2]Biomedical Research Centre, Sumy. State University, Sumy, Ukraine, [3]Zaporizhzhia State Medical and Pharmaceutical University, Zaporizhzhia, Ukraine.

P.S.44.

The combined effect of modification and grain refinement in aluminium silicon alloys

Biljana Zlatičanin, Branislav Radonjić
Faculty of Metallurgy and Technology, Podgorica, Montenegro

P.S.45.

Simplified doping-free electroluminescent device reaching 4.6% of external quantum efficiency with the derivative of 1*H*-1,2,3-triazole as emissive layer

Mariia Stanitska[1,2], Nazariy Pokhodylo[2], Roman Lytvyn[2], Ervinas Urbonas[1], Dmytro Volyniuk[1], Khrystyna Ivaniuk[3], Pavlo Stakhira[3], Rasa Keruckiene[1], Mykola Obushak[2], Juozas V. Grazulevicius[1]
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P.S.46.

1,8-Naphthalimide derivatives with room temperature phosphorescence detectable in solid and liquid media

Melika Ghasemi, Naveen Masimukku, Dmytro Volyniuk, Juozas V. Grazulevicius
Department of Polymer Chemistry and Technology, Kaunas University of Technology (KTU), Kaunas, Lithuania

YUCOMAT SYMPOSIUM B:
ADVANCED MATERIALS FOR HIGH-TECHNOLOGY APPLICATION

P.S.47.

Transport properties for Ar+ in CF_4 gas for technological applications

Željka Nikitović, Zoran Raspopović
Institute of Physics University of Belgrade, Pregrevica 118, 11080 Belgrade,Serbia

P.S.48.

Electron structure and peculiarities of the valence state of Ce (Yb) in RM_4Al_8(R=Y, Ce, Yb; M=Cr, Mn, Fe, Cu)

Ivan Shcherba[1], Henrik Noga[2], Viktor Antonov[3], Roman Bilyk[1], Bogdan Jatcyk[4], Vitalij Denys[1]
[1]Physical Department, Ivan Franko National University of Lviv, Ukraine, [2]Institute of Technology, the Pedagogical University of Cracow, Poland, [3]Institute of Physics of Metals, NASU Kyiv, Ukraine, [4]Lviv National University of Veterinary Medicine and Biotechnologies, Ukraine

P.S.49.

Dual quantum dots-doped glass nanocomposites for high-performance luminescent solar concentrators

Utku Ekim, Ali Erçin Ersundu, Miray Çelikbilek Ersundu

Yildiz Technical University, Faculty of Chemical and Metallurgical Engineering, Department of Metallurgical and Materials Engineering, Glass Research and Development Laboratory, Istanbul, Turkey

P.S.50.

SPS sintering of B_4C-SiC composites

Branko Matović

Vinča Institute of Nuclear Sciences – National Institute of the Republic of Serbia, University of Belgrade, Belgrade, Serbia

P.S.51.

New rare-earth free red-emitting $CaAl_4O_7:Cr^{3+}$crystallophosphors

Leonid Vasylechko[1], Vitalii Stadnik[1], Vasyl Hreb[1], Yaroslav Zhydachevskyy[2], Vitaliy Mykhaylyk[3]

[1]Lviv Polytechnic National University, Lviv, Ukraine, [2]Institute of Physics, Polish Academy of Sciences, Warsaw, Poland, [3]Diamond Light Source, Harwell Campus, Didcot, UK

P.S.52.

Material with a low work function based on multilayer graphene intercalated with rubidium

Evgen Len[1,2], Vitaliy Lebed[1,2], Oksana Lisova[3], Iryna Galstian[2], Stanislav Makhno[3], Mykhaylo Skoryk[2]

[1]Kyiv Academic University, NAS and MES of Ukraine, Kyiv, Ukraine, [2]G. V. Kurdyumov Institute for Metal Physics, NAS. of Ukraine, Kyiv, Ukraine, [3]Chuiko Institute of Surface Chemistry, NAS of Ukraine, Kyiv, Ukraine

P.S.53.

Low-temperature elastic, dissipative and structural properties of doped non-equiatomic high entropy alloys of the Fe-Co-Ni-Cr system

Yury Semerenko, Viktor Zoryansky

B. Verkin ILTPE of NASU, Kharkiv, Ukraine

P.S.54.

Concentrated solar radiation synthesis of metal–carbon heterostructures for low-temperature thermionic converter

Iryna Galstian[1], Eugen Len[1,2], Mykola Yakymchuk[1], Yevgen. Tsapko[1], Mykhaylo Rud[1], Mykola Shevchenko[1], Halyna Mykhaylova[1], Mykola Skoryk[1], Gennadii Frolov[3]

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P.S.55.

Using a phosphor of the high effective atomic number to recognize radioisotopes by means of absorbed dose measurement in pair with the tissue-equivalent dosimeter

Sergii Ubizskii[1], Oleksandr Poshyvak[1], Yaroslav Zhydachevskyy[2]
[1]Lviv Polytechnic National University, Lviv, Ukraine, [2]Institute for Physics, Polish Academy of Science, Warsaw, Poland

P.S.56.

Bioactive, water-based paints for camouflage painting of plastics – functional characteristic and the assessment of singlet oxygen photogeneration ability

Bartosz Kopyciński[1,3], Ewa Langer[1], Alicja Duda[2,3], Mariola Bodzek-Kochel[1]
[1]Łukasiewicz Research Network – Institute for Engineering of Polymer Materials and Dyes, Toruń, Poland, [2]Łukasiewicz Research Network – Institute of Non-Ferrous Metals, Gliwice, Poland, [3]Doctoral School, Silesian University of Technology, Gliwice, Poland

P.S.57.

Tuning the colour of topcoats – method for selection of pigments and safeguarding colour stability

Małgorzata Zubielewicz[1], Ewa Langer[1], Agnieszka Królikowska[2], Leszek Komorowski[2], Damian Wojda[2], Bartosz Kopyciński[1,3]
[1]Łukasiewicz Research Network – Institute for Engineering of Polymer Materials and Dyes, Toruń, Poland, [2]Road and Bridge Research Institute, Warsaw, Poland, [3]Doctoral School, Silesian University of Technology, Gliwice, Poland

P.S.58.

Na_2EDTA-assisted hydrothermal synthesis of $LiFePO_4$

Milica Stefanović[1], Rada Petrović[2], Đorđe Janaćković[2]
[1]Innovation Center of Faculty of Technology and Metallurgy, Ltd, Belgrade, Serbia
[2]University of Belgrade, Faculty of Technology and Metallurgy, Belgrade, Serbia

P.S.59.

Electrochemical behaviour of $Na_4Fe_3(PO_4)_2P_2O_7$ cathode in the lithium nitrate aqueous solution

Aleksandra Gezović[1], Veselinka Grudić[1], Slavko Mentus[2,3], Milica Vujković[2]
[1]University of Montenegro, Faculty of Metallurgy and Technology, Podgorica, Montenegro,
[2]University of Belgrade - Faculty of Physical Chemistry, Belgrade, Serbia,
[3]Serbian Academy of Sciences and Arts, Belgrade, Serbia

P.S.60.

Fractographic features of composite sucker rod fracture

Bohdan Bakun[1], Halyna Krechkovska[2], Bogdan Kopey[1], Myroslava Hredil[2], Oleksandra Student[2]
[1]Ivano-Frankivsk National Technical University of Oil and Gas, Ivano-Frankivsk, Ukraine,
[2]Karpenko Physico-Mechanical Institute of the National Academy of Sciences of Ukraine, Lviv, Ukraine

P.S.61.

Biodegradable mulch films obtained from unique combinations of cellulose, polycaprolactone, keratin and calcium carbonate

Aleksandra Ivanovska[1], Dušica Stojanović[2], Nemanja Barać[1], Katarina Dimić-Mišić[3], Mirjana Kostić[2], Vesna Radojević[2], Petar Uskoković[2], Đorđe Janaćković[1,2], Ernesto Barcelo[3], Patrick Gane[1,3]

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P.S.62.

Study of the impact of reaction conditions on the kinetics of 2-methylquinoline over Ru-supported catalysts

Emilija Rakić[1,2], Miha Grilc[1,3], Blaž Likozar[1,4,5,6]

[1]Department of Catalysis and Chemical Reaction Engineering, National Institute of Chemistry, Hajdrihova, Ljubljana, Slovenia, [2]Faculty of Chemistry and Chemical Engineering, University of Maribor, Maribor, Slovenia, [3]University of Nova Gorica, Nova Gorica, Slovenia, [4]Pulp and Paper Institute, Bogišićeva, Ljubljana, Slovenia, [5]Faculty of Polymer Technology, Ozare, Slovenj Gradec, Slovenia, [6]Faculty of Chemistry and Chemical Technology, University of Ljubljana, Ljubljana, Slovenia,

P.S.63.

Effect of porosity on functional properties of $Ba_{0.85}Ca_{0.15}Ti_{0.90}Zr_{0.10}O_3$ ceramics for piezoelectric and pyroelectric energy harvesting applications

Cristina E. Ciomaga[1], Nadejda Horchidan[1], Leontin Padurariu[2], Florin Tufescu[1], Ioan Dumitru[2], Vlad A. Lukacs[2], Radu S. Stirbu[2], Liliana Mitoseriu[2]

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P.S.64.

Analysis of local vs. macroscopic properties of porous $BaTiO_3$ ceramics based on 3D reconstructed ceramic microstructures

Leontin Padurariu[1], Fereshteh Falah Chamasemani[2], Roland Brunner[2], Lavinia Petronela Curecheriu[1], Vlad Alexandru Lukacs[1], Radu Stefan Stirbu[1], Cristina Elena Ciomaga[3], Liliana Mitoseriu[1]

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P.S.65.

Effect of grain size on the functional properties of 5 % Zr-BaTiO$_3$ ceramics

Vlad A. Lukacs[1], Lavinia P. Curecheriu[1], George Stoian[2], Liliana Mitoseriu[1]
[1]Dielectrics, Ferroelectrics & Multiferroics Group, Faculty of Physics, "Al. I. Cuza" University of Iasi, Iasi, Romania, [2]National Institute of Research and Development for Technical Physics, Iasi, Romania

YUCOMAT SYMPOSIUM C:
NANOSTRUCTURED MATERIALS

P.S.66.

Energy spectra and charge carriers thermodynamics in a model of high T$_c$ superconductive ceramics

Jovan P. Šetrajčić[1], Stevo K. Jaćimovski[2], Siniša M. Vučenović[3]
[1]Academy of Sciences and Arts of the Republic of Srpska, Banja Luka, Republic of Srpska, Bosnia and Herzegovina, [2]University of Criminal Investigation and Police Studies, Zemun-Belgrade, Serbia, [3]University of Banja Luka, Faculty of Sciences and Mathematics, Banja Luka, Republic of Srpska, Bosnia and Herzegovina.

P.S.67.

Hydrogen peroxide decomposition by gadolinium orthovanadate nanocrystals

Kateryna Hubenko[1,2], Pavel Maksimchuk[2], Andrey Onishchenko[3], Volodymyr Klochkov[2], Svetlana Yefimova[2]
[1]Leibniz Institute for Solid State and Materials Research Dresden,Dresden, Germany, [2]Department of Nanostructured Materials, Institute for Scintillation Materials NAS of Ukraine, Kharkiv, Ukraine, [3]Department of Physics, Kharkiv National University of Radio Electronics, Kharkiv, Ukraine

P.S.68.

High-resolution FEGSEM surface characterization of SPE-based sensors modified with polyaniline, carbon nanotubes and nanoparticles

Zoran Samardžija, Kristina Žagar, Špela Trafela, Anja Korent, Kristina Žužek, Sašo Šturm
Jožef Stefan Institute, Department for Nanostructured Materials, Ljubljana, Slovenia

P.S.69.

Photocatalytic activity of nanocrystalline NiO-CeO$_2$ catalyst and its entropy-stabilized derivatives towards Azo dyes degradation

Igor Đerđ[1], Jelena Kojčinović[1], Dalibor Tatar[1], Stjepan Šarić[1], Cora Deák[2], Zvonko Jagličić[3,4], Andraž Mavrič[5]
[1]Department of Chemistry, Josip Juraj Strossmayer University of Osijek, Osijek, Croatia, [2]Department of Applied and Environmental Chemistry, University of Szeged, Szeged, Hungary, [3]Institute of Mathematics, Physics, and Mechanics, University of Ljubljana, Ljubljana, Slovenia, [4]Faculty of Civil & Geodetic Engineering, University of Ljubljana, Ljubljana, Slovenia, [5]Materials research laboratory, University of Nova Gorica, Ajdovščina, Slovenia

P.S.70.
The final step of TEM sample preparation using NanoMill (precision ion polishing technique)
Sandra Drev, Petra Drnovšek
Center for Electron Microscopy and Microanalysis, Ljubljana, Slovenia

P.S.71.
High-energy mechanical milling-driven volumetric nanostructurization in glassy-crystalline arsenic selenides probed by annihilating positrons
Oleh Shpotyuk[1,2], Adam Ingram[3], Yaroslav Shpotyuk[4,5], Jacek Filipecki[1]
[1]O. G. Vlokh Institute of Physical Optics, Lviv, Ukraine, [2]Jan Dlugosz University in Czestochowa, Czestochowa, Poland, [3]Opole University of Technology, Opole, Poland, [4]University of Rzeszow, Rzeszow, Poland, [5]Ivan Franko National University of Lviv, Ukraine

P.S.72.
Sustainable degradation of tolperisone hydrochloride from water and its environmental toxicity on development of barley
Daniela Šojić Merkulov[1], Szabolcs Bognár[1], Ivana Maksimović[2], Predrag Putnik[3], Marina Putnik-Delić[2]
[1]University of Novi Sad Faculty of Sciences, Department of Chemistry, Biochemistry and Environmental Protection, Novi Sad, Serbia, [2]University of Novi Sad Faculty of Agriculture, Novi Sad, Serbia, [3]University North, Department of Food Technology, Koprivnica, Croatia

9.45-10.00 **Break**

FIFTH PLENARY SESSION Main Conference Hall

10.00-13.00
Chairpersons: Yuntian Zhu, Hamish L. Fraser

10.00-10.40 **PL.S.16.**
Heterostructured materials: A fast-developing new materials field
Yuntian Zhu, *Department of Materials Science and Engineering, City University of Hong Kong, Hong Kong, China*

10.40-11.20 **PL.S.17.**
Interface sliding as a deformation mechanism in Ti alloys
Zachary Kloenne, Gopal Viswanathan, Hamish L. Fraser, *Center for the Accelerated Maturation of Materials, The Ohio State University, Columbus, USA*

11.20-11.40 **Break**

11.40-12.20 **PL.S.18.**

Multifunction nanostructured coatings for corrosion protection and sensing. Contribution to a sustainable technology

Mário G. S. Ferreira, João Tedim, *Department of Materials and Ceramic Engineering, and CICECO – Aveiro Institute of Materials, University of Aveiro, Aveiro, Portugal*

12.20-13.00 **PL.S.19.**

Materials science of and for the poor

Vuk Usković, *TardigradeNano LLC, Irvine, USA and Department of Mechanical Engineering, San Diego State University, San Diego, CA, USA*

13.00-15.00 Break

First Oral Sessions, Competition for the best oral presentation, Main Conference Hall
15.00-18.30
Chairpersons: Đorđe Janaćković, Petar Usković

15.00-15.15 **O.S.1.**

Study of the structure and characteristics of new composite materials based on $AlB_{12}C_2$

Pavlo Barvitskyi[1], Prikhna Tetiana[1], Myroslav Karpets[1], Semen Ponomarev[2], Viktor Moshchil`[1], Lokatkina Anastasiia[1], Olena Prisiazhna[1], Olexander Borimskyi[1]
[1]V. Bakul Institute for Superhard Materials of the National Academy of Sciences of Ukraine (NASU), Ukraine, [2]Institute of Semiconductor Physics of the National Academy of Sciences of Ukraine (NASU), Ukraine

15.15-15.30 **O.S.2.**

Experimental investigation of the tensile properties of steel foam hollow sphere assemblies

Thomas Kalpakoglou, Stylianos Yiatros
Department of Civil Engineering and Geomatics, Cyprus University of Technology, Limassol, Cyprus

15.30-15.45 **O.S.3.**

Nanocomposites and coatings dedicated to the electromagnetic interference shielding

Adrian Radoń
Łukasiewicz Research Network, Institute of Non-Ferrous Metals, Gliwice, Poland

15.45-16.00 **O.S.4.**

Stability of solution processed transparent electrodes

Jovan N. Lukić, Vuk V. Radmilović
Faculty of Technology and Metallurgy, University of Belgrade, Belgrade, Serbia

16.00-16.15 **O.S.5.**

Optically induced electron transfer and redox-controlled modulation of optical properties in arylamino-based conjugate compounds

Francesco Ruighi[1,2], Giuseppina Anna Corrente[3], Amerigo Beneduci[3], Gianluca Accorsi[1], Eduardo Fabiano[4,5], Agostina-Lina Capodilupo[1]
[1]Institute of Nanotechnology (CNR-NANOTEC), Lecce, Italy, [2]University of Salento, Lecce, Italy, [3]University of Calabria, Arcavacata di Rende, Italy, [4]Institute for Microelectronics and Microsystems (CNR-IMM), Lecce, Italy, [5]Centre for Biomolecular Nanotechnologies (IIT), Lecce, Italy

16.15-16.30 **O.S.6.**

The NIR Cr^{3+} emission in a modified gallium oxide

Natalia Majewska, Mikołaj Kamiński, T. Leśniewski, S. Mahlik
Institute of Experimental Physics, Faculty of Mathematics, Physics, and Informatics, University of Gdańsk, Gdańsk, Poland

16.30-16.45 **O.S.7.**

Multi-modal chemo-sensing enabled by biogenic fluorescent carbon dot and its metallic nanohybrid for selective heavy metal detection and biocomputation

Ajith Manayil Parambil[1], Vinoth Kumar Ponnusamy[2] , Paulraj Rajamani[1]
[1]School of Environmental Sciences, Jawaharlal Nehru University (JNU), New Delhi, India, [2]Department of Medicinal and Applied Chemistry & Research Center for Environmental Medicine, Kaohsiung Medical University (KMU), Taiwan, ROC

16.45-17.00 **O.S.8.**

Improving adhesive properties on the plastic surface by femtosecond laser treatment

Artem Zhuravlov[1,2], Vanessa Barvinska[1,2], Anatolii Andrushchak[2], Iaroslav Gnilitskyi[1,2]
[1]NoviNano Lab LLC, 79000, Lviv, Ukraine, [2]Department of Applied Physics and Nanomaterials Science, Lviv Polytechnic National University, Lviv, Ukraine

17.00-17.15 **O.S.9.**

Ion-beam irradiated graphene oxide, 12-tungstophosphoric acid and their nanocomposites for electrochemical supercapacitors

Željko Mravik[1], Milica Pejčić[1], Jelena Rmuš Mravik[1], Blaž Belec[2], Danica Bajuk-Bogdanovic[3], Sonja Jovanović[1], Smilja Marković[4], Nemanja Gavrilov[3], Vladimir Skuratov[5], Zoran Jovanović[1]
[1]Center of Excellence for Hydrogen and Renewable Energy (CONVINCE), Laboratory of Physics, Vinča Institute of Nuclear Sciences, National Institute of the Republic of Serbia, University of Belgrade, Belgrade, Serbia, [2]Materials Research Laboratory, University of Nova Gorica, Ajdovščina, Slovenia, [3]Faculty of Physical Chemistry, University of Belgrade, Belgrade, Serbia, [4]Institute of Technical Sciences of SASA, Belgrade, Serbia, [5]Flerov Laboratory of Nuclear Reactions, Joint Institute for Nuclear Research, Dubna, Moscow region, Russia

17.15-17.30 **O.S.10.**

Strontium-doped apatitic scaffolds functionalized for sustained release of anticancer drugs against osteosarcoma

Marta Tavoni[1], Massimiliano Dapporto[1], Anna Tamperi[1], Simone Sprio[1], Fernanda Martini[2], Elisa Mazzoni[3], Monica Montesi[1]
[1]Institute of Science, Technology and Sustainability for Ceramics, National Research Council, Faenza, Italy [2]Laboratories of Cell Biology and Molecular Genetics, Department of Medical Sciences, University of Ferrara, Ferrara, Italy, [3]Department of Chemical, Pharmaceutical and Agricultural Sciences, University of Ferrara, Italy

17.30-17.45 **O.S.11.**

Silver nanoparticles for endodontic dentistry treatment

Anna Butsyk[1,2], Anders Berglund[1], Majid Ebrahimi[1], Maksym Pogorielov[3], Roman Moskalenko[2], Rafał Banasiuk[4], Jeanna Bugaytsova[1], Thomas Borén[1]
[1]Umeå University, Umeå, Sweden, [2]Sumy State University, Sumy, Ukraine, [3]University of Latvia, Riga, Latvia, [4]NanoWave, Wroclaw, Poland

17.45-18.00 **O.S.12.**

A fluorescent ratiometric potassium sensor based on IPG4-silica microparticles for selective detection and fluorescence imaging of potassium cations

Francesco Colella, Valentina Onesto, Giuliana Grasso, Helena Iuele, Stefania Forciniti, Loretta L. Del Mercato
CNRNANOTEC, National Council of Research, c/o Campus Ecotekne, Lecce, Italy

18.00-18.15 **O.S.13.**

Multifunctional Sr,Mg-doped mesoporous bioactive glass particles for biomedical applications

Tamara Matić[1], Farah Daou[2], Andrea Cochis[2], Nemanja Barać[1], Vukašin Ugrinović[1], Lia Rimondini[2], Đorđe Veljović[3]
[1]Innovation Center of the Faculty of Technology and Metallurgy Ltd, Belgrade, Serbia, [2]Department of Health Sciences, Center for Translational Research on Autoimmune and Allergic Diseases (CAAD), Università del Piemonte Orientale (UPO), Novara, Italy, [3]University of Belgrade, Faculty of Technology and Metallurgy, Belgrade, Serbia

18.15-18.30 **O.S.14.***

Chemically programmable bacterial probes for the recognition of cell surface proteins

Leila Motiei, David Margulies
Department of Chemical and Structural Biology, Weizmann Institute of Science, Rehovot, Israel

**Not participating in the best oral presentation competition*

MX-MAP Session, Small Conference Hall
15.00-17.30
Chairpersons: Lucia Delogu, Maksym Pogorielov

15.00-15.30 **O.S.15.**

Single-cell detection and biomedical applications of MXenes

Laura Fusco[1,2,3], Arianna Gazzi[1,4], Christopher Eugene Shuck[2], Marco Orecchioni[5], Acelya Yilmazer[6], Yury Gogotsi[2], Lucia Delogu[1,7]
[1]Department of Biomedical Science, University of Padua, Padua, Italy, [2]A. J. Drexel Nanomaterials Institute and Department of Materials Science and Engineering, Drexel University, Philadelphia, PA, United States, [3]Cancer Research Department, Sidra Medicine, Doha, Qatar, [4]Department of Chemical and Pharmaceutical Sciences, University of Trieste, Trieste, Italy, [5]La Jolla Institute for Allergy and Immunology, San Diego, USA, [6]Department of Biomedical Engineering, Ankara University, Golbasi, Ankara, Turkey, [7]New York University Abu Dhabi, Abu Dhabi, United Arab Emirates

15.30-16.00 **O.S.16.**

Novel PCL-MXeneelectrospun membranes for conductive tissue regeneration

Kateryna Diedkova[1,2], Alexander D. Pogrebnjak[1], Sergiy Kyrylenko[1], Pawel Zukowski[3], Yevheniia Husak[1,4], Wojciech Simka[4], Viktoriia Korniienko[1,2], Ivan Baginskiy[5], Veronika Zahorodna[5], Una Riekstina[2], Oleksiy Gogotsi[5], Yury Gogotsi[1,6], Maksym Pogorielov[1,2]
[1]Sumy State University, Sumy, Ukraine; [2]University of Latvia, Riga, Latvia; [3]Lublin University of Technology, Lublin, Poland; *[4]Silesian University of Technology, Gliwice, Poland, [5]Materials Research Center LTD, Kyiv, Ukraine; [6]Drexel University, Philadelphia, USA*

16.00-16.30 **O.S.17.**

MXene-induced energy transfer

Carmen Lorena Manzanares[1], Dahnan Spurling[2], Alan Szalai[1], Valeria Nicolosi[2], Philip Tinnefeld[1]
[1]Department of Chemistry and Center for NanoScience, Ludwig-Maximilians University, Munich, Germany, [2]School of Chemistry, Trinity College Dublin, Dublin, Ireland

16.30-16.45 **O.S.18.**

Bubble printing of $Ti_3C_2T_X$ MXene for patterning conductive and plasmonic nanostructures

Marcel Herber[1,2], Daniel Lengl[1,2], Silvano R. Valandro[1,2], Moritz Wehrmeister[1], Eric H. Hill[1,2]
[1]Institute of Physical Chemistry, University of Hamburg, Hamburg, Germany, [2]The Hamburg Center for Ultrafast Imaging (CUI), Hamburg, Germany

16.45-17.00 **O.S.19.**

Rational design of $Ti_3C_2T_x$ MXene coupled with hierarchical CoS for a flexible supercapattery

Mayank K. Singh, Dhirendra K. Rai
Sustainable Energy and Environmental Materials (SEEM) Lab, Department of Metallurgy Engineering and Materials Science (MEMS), Indian Institute of Technology Indore, Simrol, Khandwa Road, Indore, India

17.00-17.15 **O.S.20.**

Genotoxicity of $T_3C_2T_x$MXene demonstrated by DNA comet assay

Inna Chorna[1], Zhanna Klishchova[1], Anton Roshchupkin[1], Ilya Yanko[1], Ivan Baginskiy[2], Veronika Zahorodna[2], Iryna Roslyk[2], Oleksiy Gogotsi[2], Maksym Pogorielov[1,3], Sergiy Kyrylenko[1]
[1]Sumy State University, Sumy, Ukraine, [2]Materials Research Centre LTD, Kyiv, Ukraine, [3]University of Latvia, Riga, Latvia

17.15.-17.30 **O.S.21.**

Investigation of covarine particle behavior in a microfluidic mixer with artificial saliva

Miroslav Đoćoš[1], Marija Vejin[1], Alessandro Luzio[2], Elena Feltri[2], Sanja Kojić[1], Bojan Petrović[3], Goran Stojanović[1]
[1]University of Novi Sad, Faculty of Technical Sciences, Novi Sad, Serbia, [2]Center for Nano Science and Technology@PoliMi Istituto Italiano di Tecnologia, Milan, Italy, [3]University of Novi Sad, Faculty of Medicine, Novi Sad, Serbia

Thursday, September 7, 2023

Third Poster Session, National Restaurant Jadranka Terrace

08.00-09.45
Chairpersons: Željko Radovanović, Veljko Đokić

YUCOMAT SYMPOSIUM C:
NANOSTRUCTURED MATERIALS

P.S.73.

The low temperature plastic deformation of ultrafine-grained Mg-Al-RE alloy processed by ECAP

Pavel Zabrodin, Tetiana Hryhorova, Sergii Shumilin
B. Verkin Institute for Low Temperature Physics and Engineering of the National Academy of Sciences of Ukraine, Kharkiv, Ukraine

P.S.74.

Enhanced superconductivity and electron-phonon interaction in point contacts of trigonal PtBi2

Oksana Kvitnitskaya[1,2], Dmytro Bashlakov[1], Grigory Shipunov[2], Saicharan Aswartham[2], Oleg Feya[2,3], Dmitri Efremov[2], Bernd Büchner[2,4], Yurii Naidyuk[1]
[1]B.Verkin Institute for Low Temperature Physics and Engineering, NASof Ukraine, Kharkiv, Ukraine, [2]Institute for Solid State Research, IFW Dresden, Dresden, Germany, [3]Kyiv Academic University, Kyiv, Ukraine, [4]Institut für Festkörper- und Materialphysik and Würzburg-Dresden Cluster of Excellence ct.qmat,Technische Universität Dresden, Dresden, Germany

P.S.75.

The microhardness of high-entropy $Co_{0.25-x}Cr_{0.25}Fe_{0.25}Ni_{0.25}C_x$alloysin the temperature range 300-77 K

Hanna Rusakova[1], Larisa Fomenko[1], Elena Tabachnikova[1], Mikhail Tikhonovsky[2], Anastasia Levenets[2], Yi Huang[3], Terry Langdon[4]
[1]B. Verkin Institute for Low Temperature Physics and Engineering of NAS of Ukraine, 47 Nauky Ave., Kharkiv, Ukraine, [2]National Science Center, Kharkov Institute of Physics and Technology of the National Academy of Sciences of Ukraine, Kharkiv, Ukraine, [3]Department of Design and Engineering, Faculty of Science and Technology, Bournemouth University, Poole, UK, [4]Department of Mechanical Engineering, University of Southampton, Southampton, UK

P.S.76.

Microwave eccentric spherical cavities spectrum using local point-based boundary conditions method for eigenfrequencies

Zoya Eremenko, Igor Volovichev, Oleksiy Breslavets
O. Ya. Usikov Institute for Radiophysics and Electronics, National Academy of Science of Ukraine, Kharkiv, Ukraine

P.S.77.

Magnetically-controlled composites with amino-/mercapto- polysilsesquioxane coating for doxycycline sorption

Nataliia Stolyarchuk[1], Veronika Tomina[1], Inna Melnyk[1,2]
[1]Chuiko Institute of Surface Chemistry, NAS of Ukraine, Kyiv, Ukraine, [2]Institute of Geotechnics SAS, Kosice, Slovak Republic

P.S.78.

Microstructural changes of LC^3 on early-age carbonation curing at various temperatures

Katarina Šter, Andreja Pondelak, Aljoša Šajna, Sabina Dolenec
Slovenian National Building and Civil Engineering Institute, Ljubljana, Slovenia

P.S.79.

Hydrogenation properties of the Ni-Co nanostructured materials

Ihor Zavaliy, Andriy Kytsya, Yuriy Verbovytskyy, Khrystyna Vlad, Vasyl Berezovets
Karpenko Physico-Mechanical Institute of the NAS of Ukraine

P.S.80.

Photoluminescent properties of C_{60} fullerite intercalated with N_2 and H_2 molecules in a wide temperature range.

Viktor Zoryansky, Yury Semerenko, Piotr Z. Vasilievich Zinoviev
B. Verkin ILTPE of NASU, Kharkiv, Ukraine

P.S.81.

Electrochemical detection of chloramphenicol drug based on ZnO and ZnO/graphene oxide composite nanoparticles

Ana Stanković[1], Katarina Aleksić[1], Marija Kratovac[2], Ivana Stojković Simatović[2], Marijana Kraljić Roković[3], Smilja Marković[1]
[1]Institute of Technical Sciences of SASA, Belgrade, Serbia, [2]University of Belgrade, Faculty of Physical Chemistry, Belgrade, Serbia, [3]Faculty of Chemical Engineering and Technology, University of Zagreb, Zagreb, Croatia

P.S.82.

Modification of MoS_2/GO composites with ball milling and thermal treatment for catalytic application

Jelena Rmuš Mravik[1], Vladimir Rajić[2], Blaž Belec[3], Željko Mravik[1], Zoran Jovanović[1], Ivana Stojković Simatović[4], Sandra Kurko[1]
[1]Center of excellence for hydrogen and renewable energy (CONVINCE), Vinča Institute of Nuclear Sciences - National Institute of the Republic of Serbia, University of Belgrade, Belgrade, Serbia, [2]Vinča Institute of Nuclear Sciences - National Institute of the Republic of Serbia, University of Belgrade, Belgrade, Serbia, [3]Materials Research Laboratory, University of Nova Gorica, Nova Gorica, Slovenia, [4]Faculty of Physical Chemistry, University of Belgrade, Belgrade, Serbia

P.S.83.

Physicochemical properties of solvothermaly synthesized zinc copper ferrite nanoparticles

Sonja Jovanović, Jelena Rmuš Mravik, Marija Grujičić, Darija Petković, Milica Pejčić, Zoran Jovanović
Laboratory of Physics, Vinča Institute of Nuclear Sciences, National Institute of the Republic of Serbia, University of Belgrade, Belgrade, Serbia

P.S.84.

Anomalous chain confinement in chain-walking-polymerized polyethylenes as seen by advanced NMR crystallography

Jiri Brus[1], Martina Urbanova[1], Jiri Czernek[1], Larisa Janisova[1], Jan Merna[2]
[1]Department of NMR spectroscopy, Institute of Macromolecular Chemistry, Czech Academy of Sciences, Czech Republic, [2]Department of Polymers, University of Chemistry and Technology Prague, Czech Republic

YUCOMAT SYMPOSIUM D:
ECO-MATERIALS AND ECO-TECHNOLOGIES

P.S.85.

Enhancement of g-C_3N_4 with sulfuric acid treatment for the photocatalitic reduction of Cr(VI)

Jana Petrović[1], Željko Radovanović[2], Slavica Lazarević[1], Đorđe Janaćković[1], Rada Petrović[1]
[1]University of Belgrade, Faculty of Technology and Metallurgy, Belgrade, Serbia, [2]Innovation Centre of the Faculty of Technology and Metallurgy, Ltd, Belgrade, Serbia

P.S.86.

Biocompatible soil conditioners based on polysaccharide hydrogels filled with layered clays and biochar

Olena Goncharuk[1,2], OlenaSiryk[1,2], KatarzynaSzewczuk-Karpisz[1], YuriiSamchenko[2]
[1]Institute of Agrophysics, Polish Academy of Sciences, Lublin, Poland,
[2]Ovcharenko Institute of Biocolloidal Chemistry of NAS of Ukraine, Kyiv, Ukraine

P.S.87.

On biological influence of wide range non-ionizing em radiation and its bioresonance balancing prevention

Dejan Raković
University of Belgrade, Faculty of Electrical Engineering, Serbia

YUCOMAT SYMPOSIUM E:
BIOMATERIALS

P.S.88.

An artificially designed polypeptide based on elastin exon 26 primary structure showed enhanced thermo-responsive properties and improved cell adhesion

Antonella Bandiera, Laura Colomina-Alfaro, Paola Sist, Sabina Passamonti, Ranieri Urbani
Department of Life Sciences and Department of Chemical and Pharmaceutical Sciences, University of Trieste, Trieste, Italy

P.S.89.

Thermal characterization of bioactive polyphosphate glass with strontium addition

Vladimir S. Topalović[1], Srđan D. Matijašević[1], Jelena D. Nikolić[1], Veljko V. Savić[1], Marija S. Đošić[1], Snežana R. Grujić[2]
[1]Institute for the Technology of Nuclear and Other Mineral Raw Materials, Belgrade, Serbia, [2]Faculty of Technology and Metallurgy, University of Belgrade, Belgrade, Serbia

P.S.90.

Biological and bioinspired structures for multispectral surveillance

Danica Pavlović[1], Hrvoje Skenderović[2], Mario Rakić[2], Stefan Dikić[3], Dejan Pantelić[4]
[1]Institute of Physics Belgrade, University of Belgrade, Serbia, [2]Institute of Physics Zagreb, Zagreb, Croatia, [3]Faculty of Technology and Metallurgy, University of Belgrade, Serbia, [4]Senzor Infiz doo, Zemun, Belgrade, Serbia

P.S.91.

Fabrication of electrochemical immunosensors based on ZnO nanostructures

Anton Popov, Arnas Treimakas, Egita Baneviciute, Viktorija Liustrovaite, Benediktas Brasiunas, Maria Teresa Giardi, Donats Erts, Arunas Ramanavicius, Almira Ramanaviciene
NanoTechnas-Center of Nanotechnology and Materials Science, Faculty of Chemistry and Geosciences, Vilnius University, Lithuania

P.S.92.

AgNPs stability after different post treatment

Yevheniia Husak[1,2], Sergiy Kyrylenko[1], Olesia Tverezovska[1], Oksana Petričenko[3], Viktoriia Holubnycha[1], Rafal Banasiuk[4], Viktoriia Korniienko[1,3]
[1]Sumy State University, Sumy, Ukraine, [2]Silesian University of Technology, Gliwice, Poland, [3]University of Latvia, Riga, Latvia, [4]NanoWave, Wroclaw, Poland

P.S.93.

The effect of anticeptic cationic gemini surfactant decamethoxin on the keto-enol tautomerism of curcumin in the preparation of nanobiocomposites

Olga Kazakova, Valentyna Barvinchenko, Natalia Lipkovska
Chuiko Institute of Surface Chemistry, NAS of Ukraine, Kyiv, Ukraine

P.S.94.

Cell toxicity and antibacterial properties of NiTi metal alloy after plasma electrolytic oxidation

Yuliia Varava[1,2], Volodymyr Deineka[1,3], Valeriia Korniienko[1], Kateryna Diedkova[1,3], Viktoriia Korniienko[1,3], Aleksandra Franielczyk[2], Natalia Walosczyk[2], Maksym Pogorielov[1,3], Wojciech Simka[2]
[1]*Sumy State University, Sumy, Ukraine,* [2]*Silesian University of Technology, Gliwice, Poland,* [3]*University of Latvia, Riga, Latvia,* [4]*Materials Research Center LTD, Kyiv, Ukraine*

P.S.95.

Towards new approaches for ultraviolet sterilization of MXenes

Yuliia Varava[1,2], Volodymyr Deineka[1,3], Valeriia Korniienko[1], Kateryna Diedkova[1,3], Viktoriia Korniienko[1,3], Veronika Zahorodna[4], Oleksiy Gogotsi[4], Maksym Pogorielov[1,3]
[1]Sumy State University, Sumy, Ukrain, [2]Silesian University of Technology, Gliwice, Poland, [3]University of Latvia, Riga, Latvia, [4]Materials Research Center LTD, Kyiv, Ukraine

P.S.96.

Effect of various supported catalysts on selectivity and conversion of biomass-derived glycolic acid

Aleksa Kojčinović[1], Florian M. Harth[1,2], Blaž Likozar[1], Miha Grilc[1]
[1]Department of Catalysis and Chemical Reaction Engineering, National Institute of Chemistry, Ljubljana, Slovenia, [2]Institute of Chemical Technology, Universität Leipzig, Leipzig, Germany

P.S.97.

Corrosion and scratch resistance of the nanotube layer formed on the titanium-based materials

Dragana R. Mihajlović[1], Marko P. Rakin[1], Jelena B. Bajat[1], Bojan I. Medjo[1], Veljko R. Đokić[2]
[1]University of Belgrade, Faculty of Technology and Metallurgy, Belgrade, Serbia, [2]Innovation Centre of the Faculty of Technology and Metallurgy in Belgrade, Belgrade, Serbia

P.S.98.

Alginate/pectin beads with self-emulsifying system for controlled release of natural lipophilic molecules

Martina Urbanova[1], Miroslava Pavelkova[2], Katerina Kubova[2], Ivana Sedenkova[1], Jan Macku[1,2], Jiri Brus[1]
[1]Department of NMR spectroscopy, Institute of Macromolecular Chemistry, Czech Academy of Sciences, Czech Republic, [2]Department of Pharmaceutical Technology, Faculty of Pharmacy, Masaryk University Brno, Czech Republic

P.S.99.

Material analysis using accelerated ion beams

Primož Vavpetič, Žiga Šmit, Esther Punzon-Qujiorna, Sabina Markelj, Mitja Kelemen, Primož Pelicon
Jožef Stefan Institute, Ljubljana, Slovenia.

P.S.100.

Composite scaffolds for regenerative dentistry applications

Abdulrraouf Taboun[1], Marija N. Jovanović[1], Miloš M. Petrović[1], Ivan D. Pesić[2], Radmila M. Jančić-Heinemann[1], Dušica B. Stojanović[1], Petar S. Uskoković[1], Vesna J. Radojević[1]
[1]University of Belgrade, Faculty of Technology and Metallurgy, Belgrade, Serbia, [2]University of Belgrade, Institute of Chemistry, Technology and Metallurgy, Belgrade, Serbia.

P.S.101.

Exploring the potential of 4D bioprinting of smart PLGA-PEG-PLGA based hydrogel for personalized medicine

Klára Lysáková[1], Martin Sahuľ[2], Anna Finne-Wistrand[3], Lucy Vojtová[1]
[1]Brno University of Technology, CEITEC-Central European Institute of Technology, Advanced Biomaterials, Brno, Czech Republic, [2]Brno University of Technology, Faculty of Chemistry, Brno, Czech Republic, [3]KTH Royal Institute of Technology, Division of Polymer Technology, Stockholm, Sweden

P.S.102.

Dielectrophoretic manipulation of MXenes flakes

Tudor Alexandru Filip[1,2], Tăchiță Vlad-Bubulac[3], Ina Turcan[1], Marius Olariu[1]
[1]Technical University of Iasi, Faculty of Electrical Engineering, Bld. Prof.dr.doc. D. Mangeron, Iasi, Romania, [2]Academy of Romanian Scientists, Bucharest, Romania,[3]"Petru Poni" Institute of Macromolecular Chemistry, Iasi, Romania

Second Oral Session, Main Conference Hall

10.00-12.45
Chairpersons: Patrick Gane, Ewa Mijowska

YUCOMAT SYMPOSIUM A:
ADVANCED METHODS IN SYNTHESIS AND PROCESSING OF MATERIALS

10.00-10.15 **O.S.22.**

Driving nanohybrid synthesis and hierarchical assembly at interfaces with surface chemistry anisotropy

Eric H. Hill, Sanjay Jatav, Junying Liu, Marcel Herber
University of Hamburg, Institute of Physical Chemistry, Hamburg, Germany and The Hamburg Center for Ultrafast Imaging (CUI), Hamburg, Germany

10.15-10.30 **O.S.23.**

Mechanical strength and impact toughness of additively manufactured SA508 Gr.3 steel for nuclear reactor applications

Chang Kyu Rhee[1], Young-Bum Chun[1], Suk Hoon Kang[1], Wonjong Jeong[2], Taegyu Lee[3], Hongmul Kim[4], Seongjin Yoo[4], Chang Hyoung Yoo[4], Ho Jin Ryu[2,3]
[1]Korea Atomic Energy Research Institute, Yuseong-gu, Daejeon, 34057, Republic of Korea, [2]Department of Nuclear and Quantum Engineering, KAIST, Yuseong-gu, Daejeon, Republic of Korea, [3]Department of Materials Science and Engineering, KAIST, Yuseong-gu, Daejeon, Republic of Korea, [4]Advanced powder technology team, HANA AMT, Cheongwon-gu, Cheongju-si, Republic of Korea

10.30-10.45 **O.S.24.**

Synthesis and luminescent properties of "ZnO-polymer" nanoparticles

Tetiana Voitenko[1], Igor Fesych[1], Oksana Chukova[1,2], Sergiy A. Nedilko[1]
[1]Taras Shevchenko National University of Kyiv, Ukraine, [2]Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany

10.45-11.00 **O.S.25.**
Wireless electrochemical processes on two-dimensional materials
Mohsen Beladi-Mousavi[1,2], Alexander Kuhn[1]
[1]Univ. Bordeaux, CNRS, Bordeaux INP, ISM, UMR, Pessac, France, [2]Nanoinstitute Munich, Faculty of Physics, Ludwig-Maximilians-Universität München, Munich, Germany

11.00-11.15 **O.S.26.**
Influence of sintering conditions on microstructure topology in YSZ ceramic
Marek Faryna
Institute of Metallurgy and Materials Science, Polish Academy of Sciences, Kraków, Poland

YUCOMAT SYMPOSIUM B:
ADVANCED MATERIALS FOR HIGH-TECHNOLOGYAPPLICATION

11.15-11.30 **O.S.27.**
Borophene oxide with tuned chemical structure for energy related study
Ewa Mijowska, Klaudia Maslana, Krzysztof Sielicki, Klaudia Zielinkiewicz, Anna Dymerska, Tomasz Kędzierski, Beata Zielinska
West Pomeranian University of Technology, Szczecin Faculty of Chemical Technology and Engineering, Department of Nanomaterials Physicochemistry, Szczecin, Poland

11.30-11.45 **O.S.28.**
Contrasting bulk to superlattice claddings in interband cascade lasers
Borislav Petrović[1], Andreas Bader[1], Fauzia Jabeen[1], Fabian Hartmann[1], Robert Weih[2], Sven Höfling[1]
[1]Julius-Maximilians-Universität Würzburg, Physikalisches Institut, Lehrstuhl für Technische Physik, Am Hubland, Würzburg, Deutschland, [2]Nanoplus Nanosystems and Technologies GmbH, Gerbrunn, Germany

11.45-12.00 **O.S.29.**
High-entropy alloys with the supersilent microstructure
Andreja Jelen, Jože Luzar, Stanislav Vrtnik, Primož Koželj
Condensed Matter Physics Department, Jožef Stefan Institute, (Ljubljana), Slovenia

12.00-12.15 **O.S.30.**
Fracture pecularities of shape memory alloy at various frequencies of fatigue loading
Halyna Krechkovska[1], Volodymyr Iasnii[2], Oleksandra Student[1], Volodymyr Budz[2]
[1]Karpenko Physico-Mechanical Institute of the National Academy of Sciences of Ukraine, Lviv, Ukraine, [2]Ternopil Ivan Puluj National Technical University, Ternopil, Ukraine

12.15-12.30 **O.S.31.**

Sodium-ion storage mechanism investigation of vine shoots-derived hard carbon

Jana Mišurović[1], Aleksanda Gezović[1], Blaž Tratnik[2], Alen Vižintin[2], Veselinka Grudić[1], Robert Dominko[2], Milica Vujković[3]

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12.30-12.45 **O.S.32.**

Core issues of the sol-gel process for designing a high-quality polyanionic $Na_4Fe_3(PO_4)_2(P_2O_7)$ phase

Milica Vujković[1], Aleksandra Gezović[2], Danica Bajuk-Bogdanović[1], Slavko Mentus[1,3]

[1]University of Belgrade, Faculty of Physical Chemistry, Belgrade, Serbia, [2]University of Montenegro, Faculty of Metallurgy and Technology, Podgorica, Montenegro, [3]Serbian Academy of Sciences and Arts, Belgrade, Serbia

14.00 **Boat-trip around Boka Kotorska Bay**

Friday, September 8, 2023

Third Oral Session, Main Conference Hall

08.30-11.45
Chairpersons: Katarina Novaković, Sung Ho Yang

YUCOMAT SYMPOSIUM C:
NANOSTRUCTURED MATERIALS

08.30-08.45 **O.S.33.**

Surface melting of single Sn and Sn-Ge nanoparticles

Aleksandr Kryshtal[1], Sergiy Bogatyrenko[2], Olha Khshanovska[1]
[1]AGH University of Science and Technology, Kraków, Poland,
[2]V.N. Karazin Kharkiv National University, Kharkiv, Ukraine

08.45-09.00 **O.S.34.**

Design of superhydrophobic films with functional nanofillers

Konrad Terpiłowski[1], Olena Goncharuk[2], Iryna Sulym[3], Eugen Pakhlov[3]
[1]Department of Interfacial Phenomena, Maria Curie-Sklodowska University in Lublin, Lublin, Poland, [2]Ovcharenko Institute of Biocolloidal Chemistry of NAS of Ukraine, Kyiv, Ukraine, [3]Chuiko Institute of Surface Chemistry of NASU, Kyiv, Ukraine

09.00-09.15 **O.S.35.**

Wear resistance enhancement of nanocrystalline surface layer of low-alloyed steel produced by multidirectional severe plastic deformation

Olha Zvirko[1], Volodymyr Kyryliv[1], Olha Maksymiv[1], Volodymyr Gurey[2], Ihor Hurey[2,3], Yaroslav Kyryliv[4]
[1]*Department of Diagnostics of Materials Corrosion-Hydrogen Degradation, Karpenko Physico-Mechanical Institute of the NAS of Ukraine, Lviv, Ukraine,* [2]*Department of Robotics and Integrated Mechanical Engineering Technologies, Lviv Polytechnic National University, Lviv, Ukraine,* [3]*Faculty of Mechanics and Technology, Rzeszow University of Technology, Rzeszow, Poland,* [4]*Department of Organization of Scientific and Research Activities, Lviv State University of Life Safety, Lviv, Ukraine*

09.15-09.30 **O.S.36.**

Jute post-industrial waste as carbon nitride support in photocatalytic degradation of textile dyes under simulated solar light illumination

Milica V. Carević[1], Tatjana D. Vulić[1], Zoran V. Šaponjić[2], Zorica D. Mojović[3], Nadica D. Abazović[1], Mirjana I. Čomor[1]
[1]Vinča Institute of Nuclear Sciences, National Institute of the Republic of Serbia, University of Belgrade, Vinča, Belgrade, Serbia, [2]Institute of General and Physical Chemistry, Belgrade, Belgrade, Serbia, [3]Department of Catalysis and Chemical Engineering, Institute of Chemistry, Technology and Metallurgy, University of Belgrade, Belgrade, Serbia

YUCOMAT SYMPOSIUM D:
ECO-MATERIALS AND ECO-TECHNOLOGIES

09.30-09.45 **O.S.37.**

Solidified wastewater treatment sludge as a prospective supplementary cementitious material for processing pervious concrete pavements

Željko Radovanović[1], Ognjen Govedarica[2], Marina Aškrabić[2], Milica Hadnađev-Kostić[3], Tatjana Vulić[3], Branislava Lekić[2], Vladana Rajaković-Ognjanović[2], Dimitrije Zakić[2]
[1]Innovation Center of the Faculty of Technology and Metallurgy, Belgrade, Serbia, [2]University of Belgrade, Faculty of Civil Engineering, Beograd, Serbia, [3]University of Novi Sad, Department of Basic Engineering Disciplines, Faculty of Technology, Novi Sad, Serbia

YUCOMAT SYMPOSIUM E:
BIOMATERIALS

09.45-10.00 **O.S.38.**

Chitosan: From food waste to high value transformative healthcare solutions

Katarina Novaković[1], Sophie Reay[1], Emma Jackson[2], Đurđa Vukajlović[1], Emma Smith[3], Catharien Hilkens[2], Keng Wooi Ng[3], Wing Man Lau[3]
[1]School of Engineering, Newcastle University, UK, [2]Translational and Clinical Research Institute, Newcastle University, UK, [3]School of Pharmacy, Newcastle University, UK

10.00-10.15 **O.S.39.**

Prospects for the search for biocompatible materials in pathology

Roman Moskalenko
Department of Pathology, Sumy State University, Sumy, Ukraine

10.15-10.30 **O.S.40.**

Biomineralization towards synthesis of biomaterials

Sung Ho Yang
Department of Chemistry Education, Korea National University of Education, Chungbuk, Republic of Korea

10.30-10.45 **O.S.41.**

Heterogeneous hierarchical self-assembly forming crystalline nanocellulose - $CaCO_3$ nanoparticle biocomposites

Patrick Gane[1,2], Sirje Liukko[1], Katarina Dimić-Mišić[1]
[1]Aalto University, Department of Bioproducts and Biosystems, School of Chemical Engineering, Aalto, Helsinki, Finland, [2]University of Belgrade, Faculty of Technology and Metallurgy, Belgrade, Serbia

10.45-11.00 **O.S.42.**

Application of nanomaterials for the design of immunosensors

Almira Ramanaviciene, Asta Kausaite-Minkstimiene, Benediktas Brasiunas, Katazyna Blazevic, Kristina Sobol, Anton Popov
NanoTechnas-Center of Nanotechnology and Materials Science, Faculty of Chemistry and Geosciences, Vilnius University, Lithuania

11.00-11.15 **O.S.43.**

Neural cells response on femtosecond laser-induced 3D scaffold

Iaroslav Gnilitskyi[1,2,3], Alessia Mariano[4], Anna Scotto d'Abusco[4], Stefano Bellucci[3]
[1]NoviNano Lab, Lviv, Ukraine, [2]Department of Applied Physics and Nanoscience, Lviv Polytechnic National University, Lviv, Ukraine, [3]INFN-Laboratori Nazionali di Frascati, Frascati, Italy, [4]Department of Biochemical Sciences, Sapienza University of Roma, Roma, Italy

11.15-11.30 **O.S.44.**

Macrophage membrane-coated lipid nanoemulsions as biomimetic carriers of specialized pro-resolving lipid mediators for targeting atherosclerotic plaque

Maria Anghelache, Mariana Deleanu, Geanina Voicu, Florentina Safciuc, Ruxandra Anton, Delia Boteanu, Manuela Calin
Medical and Pharmaceutical Bionanotechnologies Laboratory, Institute of Cellular Biology and Pathology "Nicolae Simionescu", Bucharest, Romania

11.30-11.45 **O.S.45.**

Phage-delivering injectable gum Karaya-based hydrogel for the treatment of *S. aureus* infections

Eva Černa[1], Komárková Marie[2], Pantůček Roman[2], Plevka Pavel[3], Brtníková Jana[1], Vojtová Lucy[1]
[1]Central European Institute of Technology, Advanced Biomaterials, BrnoUniversity of Technology, Brno, Czech Republic, [2]Section of Genetics and Molecular Biology, Faculty of Science, Masaryk University, Brno, Czech Republic, [3]Central European Institute of Technology, Structural Virology, Masaryk University, Brno, Czech Republic

12.00 **Awards and Closing of the Conference**

12.30 **Farewell cocktail**

Plenary Lectures

MRS-Serbia 2023 Award

A short history of aberration-corrected electron optics and the realization of atomic-resolution electron microscopy

Knut W. Urban

Ernst Ruska Center for Microscopy and Spectroscopy with Electrons,
Research Center Jülich, RWTH-Aachen University, Jülich, Germany

Only a few years after the invention of the conventional transmission electron microscope by Ernst Ruska (1931) and the scanning transmission electron microscope by Manfred von Ardenne (1937), the first theoretical considerations were made about the resolution limit of these instruments. Otto Scherzer showed in 1936 that this limit is restricted by the aberrations of the electromagnetic lenses. The most important one is the spherical aberration, according to which the focal length of a lens is shorter in the peripheral region than in the central region. If one cuts out the peripheral area in order to get a better image, this leads to a reduced resolution. In particular, this limits the path toward atomic resolution, which Ruska already knew was in principle within the range of the electron microscope because of the short wavelength. Therefore, ways to minimize these aberrations were sought early on. A critical point here was that due to Gauss' law of magnetism, one of Maxwell's equations, it is fundamentally impossible to construct diverging lenses from round magnetic fields. This blocked the path that Ernst Abbe had taken in light optics, namely to compensate for the spherical aberration of a converging lens by combining it with a suitable diverging lens. By its very nature, circumventing a law of nature is a formidable task. It therefore took more than sixty years until we (M. Haider, H. Rose, K. Urban, *et al*., Nature 392, 768, 1998) succeeded in realizing aberration corrected electron optics with the aid of unround diverging lenses consisting of multipoles and, in 1997, in building the first microscope whose resolution was substantially greater than that of the uncorrected device.

This opened the way to atomic resolution. However, imaging atoms means entering the quantum physical world, which we know is inaccessible to intuitive perception. This may seem grotesque at times when, under initially quite unspecific conditions, one obtains images that resemble a ball-and-stick model of atomic structure. In reality, one can understand these images only when one has calculated their formation with the help of iterative solutions of the relativistically corrected Schrödinger equation. This talk gives a brief sketch of the partly quite adventurous path that has led us, against all odds, and although many had long since given up hope for it, to the visualization and measurement of atoms.

PL.S.1.

High-throughput materials discovery with nanomaterial megalibraries

Chad A Mirkin

Northwestern University, Department of Chemistry and International Institute for Nanotechnology, Evanston, IL USA

Identifying new materials that exhibit desired properties is central to everything we do as a civilization. When one considers all the metal elements in the periodic table, and all combinations of them, an infinite number of possible materials exist. This is particularly true at the nanoscale, where minor changes in size or shape at a fixed chemical composition can dramatically change the material's properties. Therefore, the ability to rapidly synthesize and screen materials with desired properties is needed. Towards that, my group has developed a nanoscale scanning probe lithography approach that, through the deposition of polymeric nanoreactors and thermal annealing, enables the preparation of "megalibraries" of as many as 5 billion positionally encoded nanomaterials with distinct chemistries, including metallic and perovskite nanoparticles. These libraries can be tailored to encompass a wide variety of alloys that are comprised of many different elements with up to four phases and six interfaces. Notably, one megalibrary contains new, well defined inorganic materials that chemists cumulatively have produced and characterized to date. In addition, we are now developing new high-throughput platforms for structural, catalytic, and optical characterization techniques that match the unprecedented speed of megalibrary synthesis. However, in materials discovery efforts, synthetic capabilities far outpace the ability to extract meaningful data from them. To bridge this gap, we present a machine-learning driven, closed-loop experimental process to guide the synthesis of polyelemental nanomaterials with targeted structural properties. Together, this approach lays the foundation for creating an inflection point in the pace at which we both explore the breadth and discover the capabilities of the "matterverse."

PL.S.2.

Super-wettability and beyond quantum-confined superfluid: biological energy conversion, chemical reaction and information transfer

Lei Jiang

Technical Institute of Chemistry, Chinese Academy of Sciences, Beijing, China

Life system presents an ultra low energy consumption in high-efficiency energy conversion, information transmission and bio-synthesis. The total energy intake of human body is about 2000 kcal/day to maintain all our activities, which is comparable to a power of ~ 100 W. The energy required for brain to work is equivalent to ~ 20 W, while the rest energy (~ 80 W) is used for other activities. All *in vivo* bio-syntheses take place only at body temperature, which is much lower than that of *in vitro* reactions. To achieve these ultralow energy-consumption processes, there should be a kind of ultra low-resistivity matter transport in nanochannels (*e.g.* ionic, molecular channels), in which the directional collective motion of ions or molecules is a necessary condition, rather than the traditional Newton diffusion. Directional collective motion of ions and molecules are considered as ionic/molecular superfluid. The research of ionic/molecular superfluid will promote the development of neuroscience and brain science, develop quantum ionic technology, construct future chemical reactors with high flux, high selectivity and low energy consumption, and produce a series of disruptive technologies.

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PL.S.3.

Understanding and controlling charge, heat, and spin at atomically precise interfaces

Paul S. Weiss

California NanoSystems Institute and Departments of Chemistry & Biochemistry, Bioengineering, and Materials Science & Engineering, University of California, Los Angeles (UCLA), Los Angeles, USA

One of the key advances in nanoscience and nanotechnology has been our increasing ability to reach the limits of atomically precise structures. By having developed the "eyes" to see, to record spectra, and to measure function at the nanoscale, we have been able to fabricate structures with precision as well as tounderst and the important and intrinsic heterogeneity of function found in these assemblies. The physical, electronic, mechanical, and chemical connections that materials make to one another and to the outside world are critical. Just as the properties and applications of conventional semiconductor devices depend on these contacts, so do nanomaterials, many nanoscale measurements, and devices of the future. We explore the important roles that these contacts can play in preserving key transport and other properties. Initial nano scale connections and measurements guide the path to future opportunities and challenges ahead. Band alignment, minimally disruptive connections, and control of spin and heat are all targets and can be characterized in both experiment and theory. I discuss our initial forays into this area in a number of materials systems.

PL.S.4.

New modifications of carbon nitrides and their use in artificial photosynthesis and single atom support

Markus Antonietti

Max Planck Institute of Colloids and Interfaces, Research Campus Golm, Potsdam, Germany

Some recent observations made polymeric graphitic carbon nitride a valuable extension to current semiconducting organic materials. This is due to the ease of synthesis, but also due to its extreme chemical stability. Made from urea under early-Earth conditions, as reported already by Justus Liebig in 1832, it just recently turned out to be a novel catalyst which, among other reactions, can even chemically activate CO_2 or photochemically turn water into hydrogen, oxygen, or more valuable compounds. This opens the door to a new chemistry on the base of a sustainable and most abundant polymer base. I will report in this presentation on new, COF-like, ionic members of the carbon nitride family which are highly crystalline and have an even increased stability with HOMO potentials down to 2.7 V. This accesses not only a cocatalyst-free full artificial photosynthesis, but also new semiconductors uses in organic electric devices that could previously not be addressed. I will also talk about photochemical pumping with carbon nitride nanostructures and how that adds an engineering component to carbon nitride photocatalysis. Due to the positive work-function the new versions are remarkably suitable for single atom deposition and thereby also a key step to extend the electron density range of known metals. Here I report on photochemical H_2O_2 synthesis and methane mono-oxidation enabled as such.

PL.S.5.

TENG - from scientific discoveries to technological innovations

Zhong Lin Wang

Beijing Institute of Nanoenergy and Nanosystems, Beijing, China, Georgia Institute of Technology, Atlanta, Georgia, USA

Triboelectric nanogenerator (TENG) was invented by my group in 2012, which is based on coupling of triboelectrification and electrostatic induction effects for converting mechanical energy into electric power. TENG is playing a vitally important role in the distributed energy and self-powered systems, with applications in internet of things, environmental/infrastructural monitoring, medicalscience, environmental science, and security. There are now over 12,000 scientists distributed in 83 countries and regions around the globe who have published papers on TENG. This presentation will first focus on the advances in fundamental science made due to the discovery of TENG. Then we will focus on the potential industrial impacts that have been made by TENG. We will show how this new field will benefit to the sustainable development of human kinds.

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PL.S.6.

Materials for 3D functional mesosystems: From neural interfaces to environmental monitors

John A. Rogers

Northwestern University, Evanston, IL, USA

Complex, three dimensional (3D) micro/nanostructures in biology provide sophisticated, essential functions in even the most basic forms of life. Compelling opportunities exist for analogous 3D structures in man-made devices, but existing design options are highly constrained by comparatively primitive capabilities in fabrication and growth. Recent advances in mechanical engineering and materials science provide broad access to diverse, highly engineered classes of 3D architectures, with characteristic dimensions that range from nanometers to centimeters and areas that span square centimeters or more. The approach relies on geometric transformation of preformed two dimensional (2D) precursor micro/nanostructures and/or devices into extended 3D layouts by controlled processes of substrate-induced compressive buckling, where the bonding configurations, thickness distributions and other parameters control the final configurations. This talk reviews the key concepts and focuses on the most recent developments with example applications in areas ranging from mesoscale microfluidic/electronic networks as neural interfaces, to bio-inspired microfliers as environmental sensing platforms.

PL.S.7.

Oriented assembly of functional mesoporous materials with multi-level architectures

Dongyuan Zhao

Department of Chemistry, Laboratory of Advanced Materials and Collaborative Innovation Center of Chemistry for Energy Materials, Fudan University, Shanghai, P. R. China

Functional mesoporous materials with multi-level architectures possess both unique properties of high surface area, large pore channels and volume based on mesostructures, and abundant optical, electrical, magnetic properties based on inorganic nanomaterials, showing great potential applications on catalysis, adsorption, separation, biomedicines and so on. Here we present the development and progress for the synthesis of the functional mesoporous nanoparticles from novel “oriented assembly” strategy by interfacial control. A series of new synthesis approaches have been developed based on the oriented assembly strategy in my group, including the confined micro-emulsion self-assembly, liquid-liquid biphase synthesis, evaporation-driven oriented/aggregation assembly, anisotropic growth of mesoporous, interface driven orientation arrangement, interfacial dynamic migration strategy *etc.* Novel mesoporous nanomaterials with one-level and multi-level architectures can be well synthesized, such as core-shell, yolk-shell, multi-shell, film structures for silica, TiO_2, carbon spheres, 3D mesoporous bouquet-posy-like TiO_2 multi-level superstructures and asymmetric Janus, single-hole hollow structure, nano-thermometer, multipods nanostructure, hemispheres, streamlined nanotadpoles, *etc.* The obtained functional mesoporous nanomaterials with regularly multi-level architectures possess uniform and controllable mesopore channels, high surface area, large pore volume, open frameworks and unique fluid mechanics showing great potential applications on catalysis, adsorption & separation, biomedicines and energy conversion & storage.

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PL.S.8.

Cobalt-free oxide cathodes for high energy density lithium batteries

Arumugam Manthiram

Department of Mechanical Engineering, The University of Texas at Austin, Austin, USA

Lithium-ion batteries have become an integral part of our daily life, powering portable electronic devices and electric vehicles. They are also intensively pursued to efficiently and economically store, utilize electricity produced from solar and wind energies. As we move forward with vehicle electrification and renewable energy storage, various factors, such as cost, energy density, power density, cycle life, safety, and environmental impact, need to be considered and balanced in designing next-generation materials and battery chemistries. Among them, cost along with sustainability and supply chain issues will be the single most dominant factor as the large-scale energy storage market is exponentially expanding. In lithium-ion batteries, the cathode comprises 50 % of the materials cost as they contain expensive and scarcely available metals like cobalt. This presentation will focus on reducing and then eliminating cobalt altogether from layered oxide cathodes, while also increasing the energy density. This is accomplished by increasing the nickel content in the cathode and replacing graphite anode with lithium-metal anode. However, increasing the nickel content to > 80 % results in severe cycle, thermal, and air instability, while lithium-metal anode suffers from cycle life limitations. The understanding gained on the bulk and surface degradation mechanisms with advanced characterization of the electrodes after large number of charge-discharge cycles and the approaches to overcome the challenges will be presented. The critical role of electrolytes and design of electrolytes that those are compatible with both high-nickel cathodes and lithium-metal anode will be covered.

PL.S.9.

Frontiers in supramolecular design of materials

Samuel I. Stupp

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The most powerful functions of materials in the living world emerge from self-assembly of molecules through highly specific noncovalent connections programmed by their primary covalent structures. The use of this bio-inspired strategy, aided by current computational advances, can create transformative soft materials. Research in our laboratory focuses on self-assembling supramolecular materials with potential impact for renewable energy, sustainability, and advanced medicine. This lecture will discuss work on materials inspired by the photosynthetic machinery of green plants that can harvest light to produce fuels for sustainable energy systems, and others in which biomolecular structures are used to program assembly in water of technologically useful structures such as ferroelectric phases. Dynamic robotic materials will also be discussed which exhibit life-like properties to effectively transduce different types of energy into mechanical actuation and locomotion of objects. The final topic will be supramolecular biomaterials that mimic extracellular matrices with unprecedented bioactivity to regenerate tissues. In this area the lecture will report on a recent breakthrough demonstrating that tuned supramolecular motion in self-assembling biomaterials can reverse paralysis by repairing the brain and the spinal cord.

PL.S.10.

Neutrophil extracellular traps (NETs) – novel target for drug delivery to various pathological sites

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Neutrophil extracellular traps (NETs) are composed of processed chromatin bound to granular and selected cytoplasmic proteins and released by neutrophils. NETs consist of smooth filaments composed of stacked nucleosomes. Fully hydrated NETs have a cloud-like appearance and occupy a space 10–15-fold larger than the volume of the cells they originate from. DNases are the enzymes that cleave extracellular DNAincluding NETs. The earliest report on NETs is dated to 1996, however the story on the crucial role of NETsin immunity, specifically innate immunity, started in 2004 when their protection against microbial invaders was demonstrated. Intense later studies followed where the presence of disease site NETs and their major role in innate immunity of the disease sites was validated for three major disease groups, namely infectious inflammations (bacterial, viral, *etc*.), sterile inflammations, (I/R, like infarctions, *etc*.), and tumors. Together with their protective role in microbial infections, NETs are involved in multiple pathological processes and represent key events in a variety of pathologies including cancer, autoimmunity, and cardiovascular disease. Sites of NETs concentration are dangerous for the host if the process of NETs formation becomes chronic or the mechanism of NETs removal does not work. NETosis has been linked to the development of thrombosis, periodontitis, cystic fibrosis, type 2 diabetes, COVID-19 or rheumatoid arthritis as well as cancer progression. In numerous studies causative association of NETs with disease site inflammation and disease severity was demonstrated and multiple NET-suppressive therapies are in preclinical and clinical studies in connection with all three afore mentioned disease group. Thus, the destruction of NETs in is of primary significance in many pathologies. On the other hand, NETsmay serve as an ideal universal target to specifically deliver drugs into disease zone in multiple pathologies, which was not explored so far. Currently, the major targets of vehicles used in targeted delivery are certaincell surface antigens specific to a disease site, or some extracellular matrix antigens, specific to the diseasesite. However, these targets differ for different pathologies and require different vehicles for targeting, while NETs could serve as a universal target. It is specifically related to NET chromatin, which is an obligatory constituent of every NET, contrary to other NET components, like various neutrophil proteins decorating NET chromatin. Monoclonal antibody 2C5 was discovered by us as a nuclear-reactive autoantibody from the B–cellrepertoire of normal aged mice. This Ab was shown to have a nucleosome restricted specificity and used intially to target cancer cells via the cancer cell surface-bound nucleosomes. Recently, mAb 2C5 has been proven to effectively recognize NETs of different etiologies, including compacted NETs.We confirmed the specificity of 2C5 toward NETs by ELISA, which showed that it binds to NETs with the specificity like that for purified nucleohistone substrate. We further utilized that feature to create two delivery systems (liposomes and micelles) in particular for DNAse I enzyme to destroy NETs, and assume that these drug delivery vehicles and also (or simultaneously with DNase) co-loaded with drugs for the treatment of the primary disease accompanied by NETs formation, such as thrombolytic enzyme for thetreatment of thrombosis or chemotherapeutics for treating cancer. In our opinion, NETs may be considered as a universal target in many diseases and mAb 2C5-modified delivery systems can serve as a universal platform for targeting multiple pathologies.

PL.S.11.

Nano- and micro-structured biosensors on stiff and flexible substrates for implantable and wearable biomarker sensing

Anne Milasincic Andrews

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We employ field-effect transistor sensors functionalized with ssDNA receptors for small molecule sensing in high-salt physiological environments. We have developed fabrication methods for hard and soft materials to produce wearable and implantable devices bearing FET sensors. We fabricated multi-FET probes on Si in 150×150 μm and 50×50 μm formats. Both formats are stiff enough for tissue implantation, while the smaller format possesses flexibility. Moreover, we developed methods for the facile fabrication of nanoribbon transistors on hard and flexible substrates, including polyimide, polyethylene terephthalate (PET), and novel temperature-responsive polymers. We have used soft formats for sensing in brain tissue and the spinal cord, and for wearable devices. We have demonstrated multiplexed serotonin, dopamine, pH, and temperature sensing via nanoribbon PET sensors. We have also developed custom hardware and software to control and record from up to eight FETs simultaneously. These and other efforts are enabling us to move toward multiplexed implantable and wearable sensing devices for use in animals and humans to improve understanding of behaviorally relevant information encoded by chemical modulators.

PL.S.12.

Transforming next generation photovoltaics with semiconductor nanostructures

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Silicon photovoltaics are regarded as part of green energy technology. However, they carry significantly longer (as high as 3 years) energy payback time. Semiconductor nanostructures are finding new ways to design light energy conversion devices (*e.g.* thin film solar cells and light emitting devices). The thin film design enabled through low temperature processing decreases the energy pay back time. The decreased consumption of energy during the manufacture and the lessened use of semiconductor materials lowers the overall carbon footprint with energy pay back time less than a year. The early studies focused on the synthesis of various semiconductor nanostructures and exploration of their size dependent optical and electronic properties. Careful engineering efforts in recent years have led to their integration in high efficiency thin film solar cells. Metal halide perovskite solar cells, in particular can now deliver efficiencies greater than 26 %, thus matching the power conversion efficiency of silicon solar cells. Recent developments in utilizing semiconductor quantum dots for light energy conversion devices and how they can influence decreasing carbon footprint will be discussed. Efforts are needed to address the stability issues, to assess environmental impacts and to transform current practices of energy utilization.

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PL.S.13.

Perovskite nanocrystals in light emitting devices

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Chemically synthesized metal halide perovskite nanocrystals have recently emerged as a new classof efficient light emitting materials which are particularly promising for development of light-emitting diodes (LEDs) [1]. Stability of perovskite-based LEDs is still an issue [2], which can be partially mitigated by proper interface design, such as the use of inter-layer amine terminated carbon dots [3]. As for many other colloidal nanocrystals, proper surface passivation is a key to ensure high colloidal stability and processability of perovskites; this can be achieved by employment of multi-amine chelating ligands [4]. We also show how water stable $CsPbBr_3/Cs_4PbBr_6$ nanocrystals with a mixed fluoropolymer shell can be applied for optical temperature sensing [5]. The use of the lead-based metal halide perovskites is also considered as an issue because of the toxicity concerns related to the lead component. To avoid using lead in light-emitting perovskites, co-doping of cerium and bismuth [6], as well as tellurium and bismuth [7] into lead-free double perovskite $Cs_2AgInCl_6$ nanocrystals is a useful strategy resulting in their improved photoluminescence efficiency.

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PL.S.14.

MXenes across the electromagnetic spectrum – from UV to microwaves

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MXenes are a very large family of 2D materials with diverse properties. They have a general chemical formula of $M_{n+1}X_nT_x$, where M represents a transition metal (Ti, Mo, Nb, V, Cr, etc.), X is either carbon and/or nitrogen (n=1, 2, 3 or 4), and T_x represents surface terminations.[1] More than 50 MXene compositions have already been reported, and more than 100 stoichiometric structures have been predicted. Availability of solid solutions on the M site (including high-entropy MXenes) and X site (including carbonitrides and oxycarbides) and control of surface terminations, such as O, OH, F, Cl, S, Se, Te, *etc*., create an opportunity for the atomistic design of numerous new structures and chemistries. Combining plasmonic properties with ease in processing, high electronic conductivity (over 20,000 S/cm) and excellent mechanical properties, MXenes can be used as optical and electronic materials. They offer chemically controlled optical and electronic properties that facilitate new ways of influencing material interactions with electromagnetic waves over UV-vis, IR, THz, and GHz ranges.[2-4] Inherent to their 2D structure, the charge carriers responsible for MXene's optical responses and electronic transport are very close to the surface that can undergo reversible chemical and electrochemical reactions to add or change surface terminations.[2] By design of the MXene composition, the carrier plasma can be rendered either sensitive to or uncommonly robust against the changes in the band structure and state-filling. MXenes have already shown great promise in applications such as electromagnetic interference shielding, photothermal therapy, electron transport layers of OLEDs and solar cells, photodetectors, and thermal radiation management. This presentation will explain how optical, electronic and transport properties of MXenes can be controlled by tuning their chemical composition. I'll also demonstrate electrochemical modulation of MXenes' optoelectronic properties[4] and describe potential photonic and optoelectronic applications of MXenes.[2-4]

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PL.S.15.

Facetted chemistry of earth-abundant nanostructured materials

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Systematic computational materials modeling strategies using first-principles methods allow one to describe and understand chemistries of already known materials, and importantly, they can be used to predict new materials and their chemistries through a careful analysis of the surface chemistry at the atomic level. In this talk, I will discuss our efforts to model chemistries of relevance for a green hydrogen economy using earth-abundant[1] materials including transition metal carbides, nitrides and oxides. Specifically, I will demonstrate how we have been able to computationally predict a) 2D MXene catalysts for electrochemical hydrogen production[2], b) 2D MXene materials for hydrogen storage, and c) oxide nanoparticles for the oxygen evolution reaction (OER)[3]. Throughout the talk, I will pinpoint the unique chemistries and catalysis taking place at the interfaces by emphasizing the role of nano-structuring, dimensionality, under-coordination and surface to name few. I will conclude by discussing some outstanding challenges and opportunities for the modeling of solid-liquid interfaces.

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PL.S.16.

Heterostructured materials: A fast-developing new materials field

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Strong and tough materials are desired for light-weight applications such as electric cars and aerospace applications. Recently, heterostructures have been found to produce unprecedented strength and ductility that are considered impossible from our textbook knowledge and materials history. Hetero structured materials consist of heterogeneous zones with dramatic (>100 %) variations in mechanical and/or physical properties. The interaction in these hetero-zones produces a synergistic effect where the integrated property exceeds the prediction by the rule of mixtures. Importantly, HS materials can be produced by current industrial facilities at large scale and low cost. There are many scientific issues with such materials that challenge the communities of experimental materials science and computational material mechanics. Heterostructured materials are quickly becoming a hot research field with multiple international conferences/workshops organized in different countries per year. In this talk I'll present the progress in heterostructured materials as well as future challenges and issues.

PL.S.17.

Interface sliding as a deformation mechanism in Ti alloys

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In this research, interface (alpha/beta) sliding has been identified as an active deformation mechanism in the recently developed a/b titanium alloy Timetal®407 (Ti-0.85Al-3.9V-0.25Fe-0.25Si-0.15O, wt.%). This deformation mechanism has rarely been reported in Ti alloys, in contrast to previous work which has identified grain boundary sliding in some cases. In this talk, the characterization of this deformation mode will be presented which involves a comparative study of the deformation behaviors in Timetal®407 and Timetal®6-4. Both alloys exhibited slip steps on their surfaces from conventional dislocation activity. However, it has been shown that Timetal®407 may also deform by a mechanism which manifests itself as sliding at alpha/beta interfaces and colony boundaries. *In situ* (SEM) deformation has been performed so that the activity of the various deformation mechanisms as a function of strain has been determined. This deformation mechanism is consistent with the ability of the alloy Timetal®407 to provide significant ductility during very high strain rate testing.

PL.S.18.

Multifunction nanostructured coatings for corrosion protection and sensing contribution to a sustainable technology

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The active corrosion protection of metallic substrates can be achieved by addition of corrosion inhibitors to protective coatings. However, direct mixing of an inhibitor with coating formulations can lead to important draw backs decreasing barrier properties of the coating and diminishing activity of the inhibitor. Also, soluble inhibitors can cause phenomena like osmotic blistering or be leached out spontaneously to the environment, which limits long-term performance and is environmentally pernicious. To overcome this problem and have controlled release of inhibitor different strategies of inhibitors storage in nanocontainers have been developed to produce smart self-healing coatings. Successful use of this technology could allow the replacement of Cr(VI) traditionally used in coatings and other surface treatments, as this is a hazardous health and environmental product. In this work novel protective nanostructured coatings with self-healing ability are presented. This effect is obtained based on nanocontainers that release entrapped corrosion inhibitors in response to local pH changes or presence of corrosive species. The development of new nanocontainers for organic and inorganic green corrosion inhibitors is described, especially the most promising from industrial point of view, based on Layered Double Hydroxides (LDH). The combination of different of these nanocontainers in the same coating system has proved to be effective to accomplish further functions as antifouling and sensing. Potential use of materials that exist in nature will also be reviewed.

PL.S.19.

Materials science of and for the poor

Vuk Uskoković

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The most laureled materials science of the day is that proliferating from the basis of immodest funding. This yields the ill and avaricious premise that the quality of research in sciences is directly proportional to the amount of funding it has received. In reality, however, research centers and labs working under the pressure of such an over abundance of resources are slaves to them. Commonly, their research objectives develop inertly and predictably, suppressing the imagination from which radical new ideas could spring to life. Curiously, in contrast, the shortage of resources forces researchers to think outside the boxes of major paradigms and motivates them to develop proposals and proofs of revolutionary new concepts. In many respects, therefore, poverty can be a blessing for researchers who look after creativity and ingenuity in their sciences. In this lecture I will present one such research that took a turn from paradigmatic to conceptually innovative as the resources for research diminished. I will also demonstrate how one such science that arises from poverty can also sometimes benefit the poor populations on Earth more than its counterparts originating from the aforementioned world's wealthiest research centers.

Oral Presentations

Sponsor Presentation

Air force office of scientific research grant funding opportunities

David Swanson
U.S. Air Force Office of Scientific Research,
European Office of Aerospace Research and Development

This presentation will highlight various opportunities to apply for research grant funding contributed by the U.S. Air Force Office of Scientific Research (AFOSR). The European Office of Aerospace Research and Development (EOARD) is part of AFOSR and is located in London in the United Kingdom. This office in London exists to support research at European Universities. The office is composed of scientists and engineers who review research topic ideas and make decisions on the best distribution of grant funding for qualified researchers and professors at European Universities. Dr. Swanson manages a portfolio of material science grants and is responsible for programs within the material science and structures topic areas.

This presentation will provide an overview of AFOSR and EOARD, as well as give detailed instructions on how professors from any university throughout Europe may inquire about and apply for grant funding opportunities. EOARD provides grants for in-house university research programs, as well as conference support, and visiting scientist travel costs to collaborate in the U.S.A. Various researchers within universities in nearly every country in Europe are currently supported by the U.S. Air Force. EOARD seeks to financially support innovative basic science that will benefit the scientific technical community at large.

Sponsor Presentation

Research interests of the army research office's science of extreme materials branch

Evan Runnerstrom

US Army Research Laboratory, USA

Dr. Evan Runnerstrom currently serves as the Program Manager for Materials Design at the United States, Army Research Office, part of the US Army Development Command. He will present an overview of the Army Research Laboratory and the Army Research Office and describe funding opportunities currently available. He will also present the research interests of the Army Research Office's Science of Extreme Materials Branch and describe specific research thrusts underway in the Materials Design Program.

Dr. Evan Runnerstrom completed his undergraduate studies at Stanford University, receiving his B.S. in Materials Science and Engineering in 2009 and a M.S. in 2010. He trained as a materials scientist at the University of California, Berkeley, receiving his Ph.D. in Materials Science and Engineering in 2016. His Ph.D. dissertation focused on charge transport processes in colloidal nanocrystal materials. He worked as a postdoc at North Carolina State University, studying plasmonic light-matter interactions in conducting oxide thin films. He came to the Army Research Office in 2019 as the Program Manager for the Materials Design Program.

Sponsor Presentation

Gain the maximum throughput with artifact-free surfaces for sample characterization by using high current plasma FIB-SEM

Martin Sláma

Tescan orsay holding, a.s.

The standard procedure for preparing cross sections using the FIB-SEM technique is to use high currents to remove material quickly, then reduce the FIB current to obtain better beam profile and consequently, a better quality for the final surface. Reducing the maximum current used for final polishing of the section surface, however, results in a longer preparation process. For small cross sections with sizes in the tens of µm, this current reduction method is acceptable. However, as the size of the cross-sectional area to be polished increases, the analysis time increases substantially; therefore, this method is not suitable for preparing cross sections with sizes in the hundreds of µm. To overcome this limitation for large cross sections, plasma FIB was introduced to deliver higher beam currents than those achievable with conventional Ga FIB-SEMs.Plasma FIB-SEM provides several advantages for sample characterization. First, its highcurrent ion beam is capable of high material sputtering rates which enables efficient preparation of large trenches or cross sections. Plasma FIB also can be used for polishing large surface areas, thereby enhancing sample features, and providing more detailed contextual information about structure and composition. about the sample. This can help to reveal material distribution, obtain better statistical information, and link the microscale to the nanoscale sample characterization. Several technologies have been introduced that improve the implementation of high current plasma FIB for large scale materials characterization. In this webinar, we will walk through the typical plasma FIB cross-sectioning workflow and discuss high current polishing methods. We will present TESCAN's TRUE X-Sectioning TESCAN Rocking Stage, which were developed to suppress artifacts and improve the final cross section surface quality when using high beam currents for final polishing. Finally, we will show how plasma FIB-SEMspeeds not only cross section preparation, but also enables a greater understanding of your materials by improving 3D FIB-SEM tomography analyses.

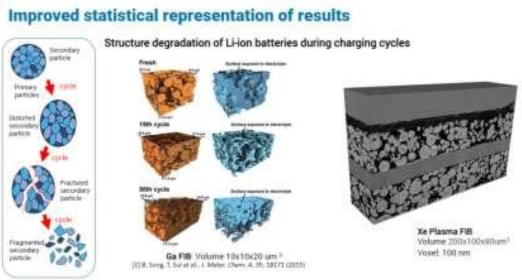

Figure 1. *Structure degradation of Li-ion batteries during charging cycles*

O.S.1.

Study of the structure and characteristics of new composite materials based on $AlB_{12}C_2$

Pavlo Barvitskyi[1], Tetiana Prikhna[1], Myroslav Karpets[1], Semen Ponomarev[2],
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The work describes the methods of obtaining new impact-resistant materials with a high level of mechanical characteristics that help protect people and equipment from the harmful effects of various types of projectiles, radiation and other influences, which play a key role in active elements and nodes of energy and transport systems, are used in modern tools for processing and manufacturing a wide range of parts and products. In the course of experimental studies of the consolidation of materials of the AlB_{12}-SiC system under hot pressing conditions at 30 MPa 1800 to 1970 ºC, the optimal thermobaric conditions for obtaining dense high-temperature materials based on $AlB_{12}C_2$ with a complex of properties that ensure high hardness, fracture toughness and damping properties were determined. The use of initial nanopowders made it possible to intensify consolidation processes, reduce synthesis and sintering temperatures, that is, to reduce the cost and simplify production technologies, as well as to improve the mechanical characteristics of materials. Features of the structure of boron carbide and aluminum dodecaborides (AlB_{12} and $AlB_{12}C_2$), namely the presence of the same structural elements - practically regular icosahedrons from boron atoms, the possibility of modifying the structure and properties by introducing additives, was the reason for conducting research in this direction aimed at creating new impact-resistant composite materials based on them, in particular, with improved ballistic characteristics. Relatively cheap nanopowders (50-150 nm, with a specific surface area of 21-15 m^2/g) α-AlB_{12} synthesized by Ph.D. V.B. Muratov (IPM NAS of Ukraine) from h-BN, Al and C in graphite crucibles were used in work.The hot pressing at 30 MPa and 1950 ˚C of two compounds from α-AlB_{12} nanopowder with 15 (I) and 20 (II) wt.% SiC addition can result in formation of ceramic elements having according to x-ray diffraction analysis 88 wt.% $AlB_{12}C_2$-12 wt.% Al_2O_3-SiC (additives) and 85.5 wt.% $AlB_{12}C_2$-14.5 wt.% Al_2O_3-SiC (additives) phases compositions respectively. Both materials turned out to be light (density ρ_I=2.6 g/cm^3; ρ_{II}=2.36 g/cm^3) and quite dense (porosity P_I=5 %; P_{II}=16 %). Samples of the first (I) material were demonstrated HV(49 N-load)= 23.3 GPa hardness, fracture toughness K_{1C}(49 N-load)=5.0 MPa m$^{0.5}$ and samples of the second (II) material showed HV(49 N-load) = 25.6 GPa, K_{1C}(49 N-load)= 5.7 MPa m$^{0.5}$ accordingly. The manufacturing of materials with the necessity to suppress the volatility of aluminum, from the structure of aluminum dodecaborides, as well as to achieve high density is discussion. The high level of characteristics can be explained by the purposeful formation of solid solutions in the samples of the obtained composite ceramics.

The investigations were performed in the frames of the project NATO SPS G5773 «Advanced Material Engineering to Address Emerging Security Challenges» for 2020–2023, the National Acad. Sci. of Ukraine project under «Support for development of priority national research» program), the project III-3-20 (0786).

O.S.2.

Experimental Investigation of the tensile properties of steel foam hollow sphere assemblies

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Metal foams are man-made materials that replicate structures of nature, such as bones or woods, etc. that exhibit interesting physical and mechanical properties with a high range of applications in the industry (Zhao *et al.*, 2017; Patel, Bhingole and Makwana, 2018). The mechanical properties under compression are probably the most well studied for metal foams and porous metals, as indicated by the publication of a standard method for the compression of porous metals (ISO 13314, 2011), the only test method with a dedicated standard for investigating the mechanical properties of porous metals, being under uniaxial compression. The lack of standards for reliably determining mechanical properties in tension and shear is a barrier in further industrial application. This work focuses on ongoing work in developing a reliable method for determining the mechanical properties of metal foam hollow sphere assemblies under uniaxial tension. We will present the specimen prototyping steps and the experimental procedure to test and determine mechanical properties such as Elastic Young's Modulus and maximum tensile strength. For the specimens in question we used metal foam hollow spheres of two different diameters (2mm and 4mm). The different test steps are presented alongside results and comparisons are made for the effective and reliable tensile properties determination.

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O.S.3.

Nanocomposites and coatings dedicated to the electromagnetic interference shielding

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EMI shielding composites and coatings are prevalent in various fields, including medical, military, and aerospace, due to their ability to protect electronic devices from electromagnetic attacks and reduce self-generated electromagnetic noise for secure communication. While metallic-based materials offer good EMI shielding, their limitations, such as low corrosion resistance, heavyweight, and poor mechanical flexibility, have prompted investigations into composites. Two main types of composites have been studied in this field: those with conductive fillers, such as carbon nanostructures and conductive polymers, for reflecting electromagnetic waves and those with non-conductive magnetic fillers for absorbing EM waves due to their high magnetic losses.This study focuses on enhancing the EM absorption properties of coatings and nanocomposites, particularly dedicated for 3D printing processes. The first part of the study explores the potential of incorporating entropy-stabilized ferrites into a typical 3D printing polymer matrix. It was confirmed that incorporating of high-entropy particles significantly improves the EMI shielding properties of pure acrylonitrile butadiene styrene matrix (from 0 to 85.5% at 2.72 GHz). The second part of the study involves synthesizing non-conductive ferrites-based hybrid nanoparticles (NPs) with varying magnetic properties. The different combinations of Fe_3O_4, $NiZnFe_2O_4$, and $CoFe_2O_4$ NPs were tested to identify the most promising nanostructured fillers. Based on the research, it was found that the deposition of ultrafine $CoFe_2O_4$ NPs on the surface of magnetite nanoparticles with the shape of truncated octahedron resulted in the highest increment of reflection losses, achieving -36.86 dB @ 1.75 GHz. The research findings propose a production method for EMI shielding paints and filaments with high potential for practical application that combine various magnetic nanofillers.

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O.S.4.

Stability of solution processed transparent electrodes

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With the growing need for more efficient optoelectronic devices, the demand for optimizing individual components soon follows. For the application in these devices, transparent electrodes (TE) require high optical transmittance and low sheet resistance as well as adequate electrical, thermal and chemical stability. In recent years silver nanowires (AgNWs), with their excellent conductivity and transmittance coupled with their good mechanical flexibility and the option of being solution processed, have been considered promising alternatives to current industry options. Nevertheless, low adhesion, high surface roughness and low thermal, electrical and chemical stability hinder further application of these TE. A way of overcoming these drawbacks is to introduce protective layers through the formation of nanocomposite structures, with n-type metal oxides frequently used due to their high electron mobility, high transmittance and low contact resistance with AgNWs. In this work AgNW/ZnO nanocomposites have been fully solution processed through spin coating, where ZnO was coated multiple times onto AgNWs which were previously thermally welded in order to decrease the junction sheet resistance. AgNW/ZnO samples were studied for electrical and chemical degradation, where optical and electrical properties were analyzed before and after degradation.

O.S.5.

Optically induced electron transfer and redox-controlled modulation of optical properties in arylamino-based conjugate compounds

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Organic conjugate compounds are gaining increasing attention in many optoelectronic applications due to their low-cost, mild fabrication processes and easy tunability. Among them, diarylamino-based compounds with donor-π-donor (D-π-D) structure have been investigated owing to their fascinating intramolecular electron transfer processes[1]. In this regard, we synthesized different D-π-D diarylamino-based compounds to study the dependence of such electron transfer processes on the π-conjugated moiety. Given their electrochemical reversibility and the unique optical characteristics of their oxidized species, they are promising candidates as electroactive materials for electrochromic devices [2-4].

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O.S.6.

The NIR Cr^{3+} emission in a modified gallium oxide

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Due to potential biological applications, the Cr^{3+}-activated luminescent materials have recently become a research hotspot worldwide[1, 2]. Recently, Cr^{3+}-activated luminescent materials that can produce either sharp-line or broadband spectra have become a promising candidates in phosphor-converted IR light-emitting diodes (pc-IR LEDs). It found application in the food's freshness, quality, and composition analysis.[3] One of the main goals is to find a material with efficient broadband NIR luminescence. One of the promising materials for NIR sources is Ga_2O_3 activated by Cr^{3+} ions. These materials are characterized by efficient NIR luminescence in 650 to 900 nm range, with the maximum at 740 nm. Here the luminescence studies, time resolve studies, and high-pressure spectroscopy are shown for Cr^{3+} activated Ga_2O_3 doped with Sc, and Al. Co-doping the Ga_2O_3 matrix with the ion with a bigger ion radius like scandium allowed us to shift the maximum emission to 850 nm with a high efficiency >90 %. $Ga_{1.594}Sc_{0.4}O_3{:}0.006Cr^{3+}$ exhibits high internal quantum efficiency (99 %). Time-resolved spectra are utilized to further examine the subtle change in the microstructures of Cr^{3+}. For the undoped sample, only one luminescence center is observed. By contrast, for the Sc doped samples, the two emission spectra taken in different time interval are considerably different, which suggest that the distribution of crystal field strength spans over the crossing point of the ^2E and $^4T_2$ states, and the Cr^{3+} luminescence centers are located in strong and weak crystal fields. Accordingly, we can simultaneously observe broadband and line emissions even at low temperatures. For a series of $Ga_{1.98-x}Al_xO_3{:}0.02Cr^{3+}$ phosphors, structural evolution reveals a crystal phase change with the incorporation of Al ions. The phase transition is also observed by high-pressure studies. Between 120-140 kbar, the luminescence spectra and the decay times change, which suggests the phase transition from β-Ga_2O_3 (monoclinic) to α-Ga_2O_3 (trigonal). Similar high-pressure behavior is found in $Ga_{1,98-x}(Al_{0.68}In_{0.32})_xO_3{:}0{,}02Cr^{3+}$. Using high pressure at the diamond anvil cell, we obtained the new sample in the α phase, which luminescence properties have not been studied so far. From the photoluminescence study, it is seen that the broadband emission of α- $Ga_{1,98-x}(Al_{0.68}In_{0.32})_xO_3$: $:0{,}02Cr^{3+}$ is shifted to about 50 nm and is significantly broadened compared to the sample at β-phase, which is of interest in the context of the application as LED-based NIR emitter.

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O.S.7.

Multi-modal chemo-sensing enabled by biogenic fluorescent carbon dot and its metallic nanohybrid for selective heavy metal detection and biocomputation

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This study presents the development of a synergistic platform for multi-modal chemo-sensing using biogenic fluorescent carbon dots (C-dots) and silver nanoparticle-decorated C-dots (Ag@C-dots) nanohybrid. The platform demonstrates excellent sensitivity and selectivity towards Fe^{3+} with a minimum LOD of 0.76 ppm, and colorimetric sensing and fluorescence quenching in response to Fe^{3+}, resulting in aggregation and yellowish-brown clumps. The study also showcases the use of Ag@C-dots as a platform for molecular logic gates (MLGs) by constructing an advanced logic system, IMP-OR gate, using additional inputs such as ascorbic acid and urea. Two different forms of biogenic C-dots, thiol-functionalized (TC-dots) and acid-functionalized (AC-dots), were chemically functionalized and applied as MLGs for multi-stimulus responsive computing. A logic library representing 15 fundamental logic gates and their combinational operations, a parity checker that distinguishes 0 to 9 natural integers as even or odd, and a pattern-mediated molecular keypad lock were developed using the C-dot platforms and analytes such as Fe^{3+}, Hg^{2+}, ascorbic acid, glucose, dichlorvos, and H_2O_2. The proposed molecular keypad lock has the potential for use in different fields such as electronic gadgets, security systems, sensors, and therapeutics. The synergistic design of biogenic fluorescent C-dots and Ag@C-dots nanohybrid offers a promising platform for selective heavy metal detection and biocomputing applications.

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O.S.8.

Improving adhesive properties on the plastic surface by femtosecond laser treatment

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In this paper, we used femtosecond laser to form anisotropic and isotropic surface modification on Teflon. Adhesion properties of laser-modified Teflon surface were studied and discussed. Surface modification using a femtosecond laser has become a popular technique for altering the chemical and morphological properties of materials [1]. This method offers superior control over the surface properties, resulting in enhanced performance in many applications [2]. Compared to other techniques, such as chemical or mechanical methods and lithography, femtosecond laser treatment is a faster, more cost-effective, and environmentally friendly process. Polytetrafluoroethylene (PTFE), also known as Teflon, is a widely used polymer known for its chemical resistance and low adhesion properties [3]. However, the challenge lies in processing PTFE into blanks for painting and sticking. In order to overcome this issue, we propose using laser engineering to modify the surface of PTFE and improve its adhesion.In this study, we conducted two experiments using a Femtosecond Laser to treat the PTFE surface in parallel and cross modes with specific parameters. These regimes allowed us to obtain isotropic and anisotropic surfaces.Our results showed that the femtosecond laser treatment of the PTFE surface led to significant improvements in its adhesive properties. Before irradiation, the surface was cleaned with methanol and the experiments were conducted at an air temperature of 20°C. After performing the tear-off test, we observed that the adhesion of the treated anisotropic surface was approximately four times higher than that of the untreated surface (0.8 mPa and 0.2 mPa, respectively).

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O.S.9.

Ion-beam irradiated graphene oxide, 12-tungstophosphoric acid and their nanocomposites for electrochemical supercapacitors

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Ion beam modification of materials is notable method for achieving their unique structural, electronic, and other physicochemical properties. In the case of graphene oxide (GO) such modification of structure and surface chemistry is known to yield properties interesting for electrochemical supercapacitors. The performance of GO supercapacitors can be additionally improved by incorporating components with attractive redox properties. In this work, the influence of ion beam irradiation on synergy of GO and 12-tungstophosphoric acid (WPA) in their nanocomposite was investigated. For that, both components and their composites with different mass ratios were irradiated using different ion species, fluences and energies (from 10 keV C to 710 MeV Bi). For the irradiated WPA, results showed clear correlation between ion beam parameters, degree of structural modification and electrochemical properties. With increasing structural modification, bond breaking is first induced giving higher catalytic activity toward HER. Further irradiation resulted in an increased interconnection of polytungstate species producing lower catalytic activity and lower lithiation capacity. Irradiated GO showed modified surface chemistry, with preferable reduction of alkoxy and epoxy groups, changes in morphology and electric properties due to increased number of defects with increasing fluence**,** synergic effect of ion beam irradiated GO and WPA resulted in higher capacitance of irradiated composites compared to GO presumably because of interaction of structurally modified WPA with defect sites on GO thus reducing electrolyte flow along ion tracks.

O.S.10.

Strontium-doped apatitic scaffolds functionalized for sustained release of anticancer drugs against osteosarcoma

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Osteosarcoma (OS) is an aggressive malignant bone cancer that primarily affects children and adolescents. Current treatments of bone cancer involve surgical removal of the affected bone and systemic administration of high doses of anticancer drugs to achieve effective drug concentrations in the bone tissue. However, the high drug concentration in the blood can induce serious side effects in other organs and tissue. Therefore, developing devices that can combine bone regeneration with effective drug delivery to the bone tumour site without reaching toxic levels in the blood is an active area of research. Self-hardening strontium-doped apatitic bone scaffolds (Sr-CPCs) are today of great interest due to their osteogenic and osteointegrative abilities and considered as effective to sustain bone regeneration even under impaired conditions such as osteoporosis. The possibility to functionalize these materials with anticancer drugs paves the way for developing new smart implants to treat bone cancer by combining the regenerative capabilities of Sr-CPCs with the anticancer ability of drugs. In this work, drug-loaded Sr-CPCs were developed as porous bone scaffolds functioning as drug delivery systems for the local administration of methotrexate and doxorubicin. The drug release profiles, and the biological performance *in vitro* of the drug-loaded Sr-CPCs were evaluated. In addition, to elucidate the drug release mechanisms, the data describing the drug release profile were fitted with mathematical models. The results of this work can open to future therapies aimed at combining bone regeneration and anticancer therapy, promising to solve critical and still unmet clinical needs.

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O.S.11.

Silver nanoparticles for endodontic dentistry treatment

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Introduction: Silver nanoparticles (AgNPs) are promising nanomaterials for translational applications in clinical medicine and dentistry. Due to their small size, shape and extensive surface-to-volume ratio, AgNPs have demonstrated to exhibit novel antimicrobial properties and functional alternatives to antibiotics. Here we explore how these antimicrobial AgNPs, with a focus on bacterial growth reduction, can be applied to the clinical disciplines in dentistry. *Enterococcus faecalis* is a member of the gastro-intestinal and oral microbiome and often found in persistent dental root-canals infections. *E. faecalis* readily forms persistent biofilms in the root canals, which is the main cause of the secondary infections. This often results in costly and complex endodontic treatments. The antimicrobial properties of the AgNPs can be applied as long-lasting alternatives to antibiotics, and to eradicate and protect from chronic bacterial infections in the dental root canal. By so doing, the AgNPs will help improve the quality and long-term stability of endodontic treatments and dental restorations. Thus, our project aims to develop novel antimicrobial applications for endodontic treatments. Methods: The detailed morphology and size variation of AgNPs were determined by combinations of scanning and transmission electron microscopy. The antimicrobial properties of AgNPs were tested and both Gram-positive and Gram-negative gastro-intestinal bacteria were found to be sensitive. A dental model was developed to test the AgNPs properties for applications in endodontic treatment.Results: AgNPs demonstrate concentration-dependent antimicrobial activity against both the Gram-positive and Gram-negative gastro-intestinal bacteria. The dental tooth-model reproducible identified infection by *Enterococcus faecalis* and can be applied to investigate the bactericidal efficiency against endodontic *E. faecalis* infections.

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O.S.12.

A fluorescent ratiometric potassium sensor based on IPG4-silica microparticles for selective detection and fluorescence imaging of potassium cations

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Potassium cations (K^+) play many important roles in living organisms, especially in electrophysiology, being involved in neurotransmission and muscle contractions. Dysregulations in K^+ homeostasis is involved in pathophysiological events, mainly cardiac dysfunction (such as cardiac arrhythmia) and central nervous system dysfunction (such as migraine and epilepsy). There is also evidence that K^+ ions accumulation might play a role in cancer, by creating a hostile environment for immune cells. We report the synthesis of a ratiometric fluorescent microsensor for K^+ live imaging, based on the fluorescent probe ION potassium green 4 (IPG4, ION Biosciences). Potassium cations-sensitive fluorescent microparticles were obtained by using silica (SiO_2) as starting material. We obtained silica-based microsensors with a size in the micrometer range, spherical shape, good monodispersity and a sensitivity range between 0 to 30 mM. The microsensors also proved to be suitable for confocal laser scanning microscopy (CLSM), offering new possibilities for the study of human diseases in in vitro platforms.

O.S.13.

Multifunctional Sr,Mg-doped mesoporous bioactive glass particles for biomedical applications

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Mesoporous bioactive glass particles (MBGPs) doped with therapeutic ions present the latest generation of the sol-gel glasses, having high surface area and large pore volume that allow loading of drugs. Magnesium ion is known to have pro-angiogenic character, while strontium has pro-osteogenic properties which have stimulating effect on bone regeneration. The aim of this study was to develop Sr,Mg-doped MBGPs and to characterize them for possible application as multifunctional particles for simultaneous bone regeneration and drug delivery, as well as a component in biocomposite scaffolds for bone tissue engineering. The Sr,Mg-doped MBGPs were synthesized by ultrasound-assisted microemulsion sol-gel technique and their morphological, biological, textural, and drug delivery properties were characterized. Drug loading and release were tested using ibuprofen. Moreover, the Sr,Mg-doped MBGPs were mixed with hydrothermally obtained hydroxyapatite doped with 3 mol.% of strontium and magnesium to obtain biocomposites scaffolds by the sponge replica method. The biological and mechanical properties of obtained biocomposite scaffolds were tested for potential application in bone tissue engineering. The Sr,Mg-doped MBGPs were successfully developed and they showed simultaneous release of ibuprofen as well as Sr and Mg ions for stimulated cell proliferation, angiogenesis and osteogenesis. They were shown to also have a strengthening effect on the compressive strength of biocomposite scaffolds based on hydroxyapatite for bone tissue engineering. Overall, the Sr,Mg-doped MBGPs present promising multifunctional particles for biomedical applications.

O.S.14.*

Chemically programmable bacterial probes for the recognition of cell surface proteins

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In living cells, information is processed and transferred via a series of recognition and signaling events, which normally begin by the binding of cell-surface receptors to extracellular signals, such as small molecules or proteins. In recent years, there has been considerable interest in modifying cells with artificial receptors, as a means to provide them with new properties. We have recently reported a method for decorating bacterial surface with self-assembled synthetic receptors based on modified DNA duplexes.[1-4] When integrated with DNA nanotechnology, bacterial surface engineering benefits from the ability to modify the bacteria with well-defined nanostructures, which are inherently water-soluble, biocompatible, and can be constructed in a programmable and predictable manner via simple self-assembly processes. This structural programmability enabled us to create bacterial probes (B- probes) that can label distinct types of cancer cells with distinct colors, as well as to generate very bright B-probes with higher sensitivity of fluorescence in which the multiple dyes are spatially separated along the DNA scaffold to avoid self-quenching. In addition, we have shown that a similar strategy can be applied to endow bacteria with new properties, such as an ability to glow with different colors, adhere to surfaces, and interact with proteins or cells, properties that may eventually be used in developing cell-imaging methods, living materials, and devices, as well as live cell-based therapeutics and diagnostic systems, respectively.

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O.S.15.

Single-cell detection and biomedical applications of MXenes

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Two-dimensional (2D) transition metal carbides, nitrides, and carbonitrides (MXenes) are rapidly growing as nanoplatforms in biomedicine. To satisfy a critical unmet need to detect 2D materials at the single-cell level while measuring multiple cell and tissue features, we proposed a label-free single-cell strategy based on single-cell mass cytometry (CyTOF) and ion-beam imaging by time-of-flight, enabling nanomaterial detection while surveying a high degree of information from single samples.[1] We demonstrated MXene detection in 15 human immune cell populations. *In vivo* biodistribution experiments confirmed the versatility of our strategy and revealed MXene accumulation in the main organs. In addition, we demonstrated MXene antiviral activity on SARS-CoV-2/clade GR-infected Vero E6 cells.[2] MXene immune profiling revealed i) the excellent bio and immune compatibility of the material, as well as the ability of MXene ii) to inhibit monocytes and iii) to reduce the release of pro-inflammatory cytokines. Finally, we synthesized V_4C_3, evaluating its biocompatibility and immunomodulatory effects.[3] We demonstrated the ability to inhibit T cell-dendritic cell interactions, evaluating the modulation of CD40-CD40 ligand interaction, two key co-stimulatory molecules for immune activation. Our findings set the basis for further V_4C_3 investigation as a negative modulator of the immune response in inflammatory and autoimmune diseases. Taken together, our results provide a compendium of knowledge on the biocompatibility of MXenes for the safe development of multi-functioning nanosystems in biomedicine.

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O.S.16.

Novel PCL-MXene electrospun membranes for conductive tissue regeneration

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The development of conductive biomaterials has emerged as a promising approach for enhancing tissue regeneration, due to their unique ability to promote electrical communication between cells and tissues. However, the application of metallic nanoparticles, conductive polymers, and graphene for this purpose is limited by potential toxicity, inappropriate host response, and low reproducibility. A novel class of conductive 2D materials, MXenes, may offer a solution to these limitations and open new perspectives in conductive tissue regeneration and engineering. We developed highly porous, biocompatible, biodegradable electrospun membranes using Poly-caprolactone (PCL), followed by the immobilization of $Ti_3C_2T_x$MXenes to make the final composite conductive. Before MXene immobilization, we used several pretreatment methods, such as alkali solution and oxygen plasma, to increase the hydrophilic properties of the PCL membranes. We provided detailed characterization of the novel composite material using various structural (SEM, TEM, HRTEM, HAADF, and STEM) and chemical (FTIR, EELS, XPS) methods, and conducted investigations of conductivity and positron annihilation to choose appropriate materials for biological investigation. Our findings demonstrate that PCL-MXene membranes possess appropriate porous structures with high hydrophilic surfaces, which are well-suited for tissue engineering constructions. Additionally, the material exhibits both inductive and capacitive properties, as well as high biocompatibility and antibacterial potential, making it an ideal candidate for cardiac and nerve tissue substitutes.

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O.S.17.

MXene-induced energy transfer

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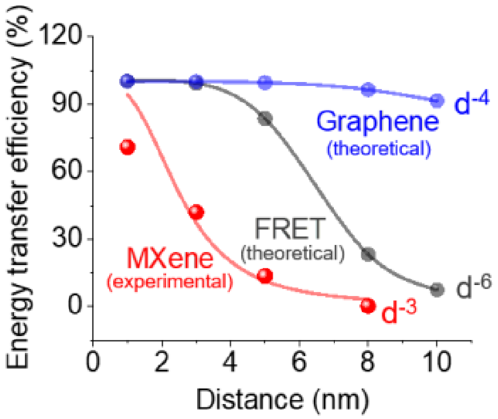
MXenes, a class of 2D materials discovered in 2011, have potential applications in energy storage, electromagnetic shielding, and optoelectronics. Yet, the energy transfer properties of this family of materials remain elusive, which may have implications in several fields. In this study, we used single-molecule fluorescence microscopy and DNA origami nanopositioners to investigate the distance-dependent fluorescence lifetime of an emitter on transparent thin films made of spin-coated $Ti_3C_2T_x$ MXene 2D flakes. We developed a specific immobilization chemistry for DNA origami nanostructures, which allowed us to control their orientation on the surface with precision. Our findings show that when the dye was positioned between 1 nm and 8 nm from the surface, the fluorescence was quenched following a distance dependency of d-3. These results agree with the long-standing mechanism of short distance energy transfer with transparent conductors at the bulk level. MXenes could serve as short-distance spectroscopic nanorulers for measuring biomolecular processes, providing a high level of sensitivity at a distance range that conventional energy transfer tools do not access.



O.S.18.

Bubble printing of $Ti_3C_2T_X$ MXene for patterning conductive and plasmonic nanostructures

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MXenes are a recent addition to the family of 2D materials with many significant and unique properties such as excellent conductivity, plasmonic properties, and resistance to high temperatures. These properties have led to their use in many applications, including energy storage, electronics and sensors. Until now, inkjet printing, screen printing and 3D extrusion printing have been the main methods for printing MXenes, however, optically directed approaches have so far not been demonstrated. Optically controlled microbubbles can be used to pattern colloidal particles on substrates. Briefly, a microbubble is formed at the interface between the substrate and the colloidal suspension, which attracts colloidal particles due to Marangoni convection and immobilizes them on the substrate through van der Waals interactions. Previous approaches have shown printing of conductive patterns with silver nanoparticles and conductive polymers, and recent work has demonstrated the printing of patterns with gold nanoparticles toward plasmonic sensors. A major limitation of the use of noble metal nanoparticles in bubble--printing approaches is their low melting point, which leads to melting and loss of plasmonic sensing capabilities. Herein, bubble-printing was used to print a colloidal dispersion of MXene nanosheets onto a non-plasmonic substrate without degradation to obtain conductive and plasmonic patterns. Overall, this work lays the foundation for future studies of optically-directed assembly of MXenes at interfaces, which will advance the fabrication MXene-based sensors and electronics, and will promote applications in which high heat resistance and conductive or plasmonic properties is essential.

O.S.19.

Rational design of $Ti_3C_2T_x$ MXene coupled with hierarchical CoS for a flexible supercapattery

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Flexible energy storage materials are finding much research interest due to their high demand in the rapidly growing wearable electronics industry. For the fabrication of such devices, the electrode material should possess high flexibility as well as high mechanical stability. Besides having these prerequisites, 2D metal carbides/nitrides/carbonitrides (MXenes) are well-established electrode materials due to their excellent conductivity, high specific surface area, and ion intercalation properties. This work reports on a fabric-based flexible electrode material fabricated by in-situ growth of CoS on carbon cloth fibers (CC) followed by drop-casting of $Ti_3C_2T_x$ MXene layer. The resulting electrode $Ti_3C_2T_x$/CoS@CC, owing to the synergy between hydrophilic and highly conductive $Ti_3C_2T_x$ and redox-active CoS, shows an excellent augmentation in its supercapattery features (120 Cg^{-1} at 1 Ag^{-1}) compared to its individual components (10.4 and 60 Cg^{-1} for $Ti_3C_2T_x$ and CoS, respectively, at 1 Ag^{-1}). The kinetic and charge storage mechanism studies reveal the faradic battery-type character of the electrode, mainly because of the redox nature of CoS, which is reinforced by highly conducting MXene. Furthermore, the fabricated flexible symmetrical device using $Ti_3C_2T_x$/CoS@CC electrode shows a maximum energy density of 13.13 $Wh.kg^{-1}$ and maximum power density of $1.91 kW.kg^{-1}$ with 93.41% retention in capacity after 10000 cycles. The superior flexible character of the electrode is confirmed by its unaltered electrochemical performance under varying mechanical stress (stretching, bending, and twisting). The fabrication and electrochemical performance of $Ti_3C_2T_x$/CoS@CC electrode open new possibilities for rationally designing efficient electrode materials for next-generation flexible electronic devices.

O.S.20.

Genotoxicity of $T_3C_2T_x$MXene demonstrated by DNA comet assay

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MXenes are a new class of 2D materials widely recognized as promising candidates for a broad range of technological applications due to their unique properties. One of the potential risks associated with MXenes is their genotoxicity, which refers to their ability to damage genetic material (DNA) in cells. Several recent studies have investigated the toxicity of MXenes and shown conflicting results. Therefore, more research is needed to fully understand the potential risks associated with MXenes and to develop appropriate safety regulations and guidelines for their use. The DNA comet assay is a sensitive technique used in genotoxicity testing to determine the extent of DNA damage in cells. The cells are embedded in agarose and lysed, and then subjected to electrophoresis which causes the DNA to be drawn out into a comet-like tail shape. The longer the tail, the greater the extent of DNA damage. The DNA comet assay is a versatile and powerful tool for understanding the mechanisms of DNA damage and repair and has applications in fields ranging from toxicology to cancer research. We applied comet assay to investigate the effect of the presence of MXenes on the DNA integrity in B16F10 mouse melanoma cells. MXene was added to cells in culture at 6.25, 25 and 100 µg/ml for 4 hrs and was washed away. The cells continue to grow for additional 3 days, after which the cells were trypsinised and analysed with the alkaline DNA comet assay. We observed robust appearance of DNA comets induced by MXene in a dose dependent manner. The degree of the DNA damage in our experiment did not correlate well with the apparent lack of toxicity of MXene in the melanoma cells and intensive cell growth after the MXene treatment. It is assumed that MXenes are generally well tolerated in biological systems. Currently, we investigate the mechanism of the observed effect of the MXene on the DNA comets. We suggest that the genotoxicity of MXenes needs to be further evaluated to ensure their safe use in various applications.

Acknowledgements: This research received support from the Horizon Europe MSCA-2021-SE-01 project 101086184 MX-MAP, Ukraine MES grant 0122U000784 and Erasmus+ Jean Monnet Chair project 101085451 CircuMed.

O.S.21.

Investigation of covarine particle behavior in a microfluidic mixer with artificial saliva

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Covarine is a commonly used ingredient in tooth whitening toothpastes. Different technologies have been employed to incorporate covarine into toothpaste formulations, resulting in various forms of the product. These technologies include the use of bigger flakes, two-phase pastes, and microbeads. The present investigation aimed to evaluate the behavior of covarine particles in Colgate Advanced White toothpaste, where covarine is present in the form of microbeads with a size of 200 microns after mixing with artificial saliva (AS) in both microfluidic mixer and Comsol simulations.The microfluidic mixer was designed with 400-micron wide channels arranged in a serpentine form with 30 serpentines. The mixer also featured a Y-shaped design with two inlets: one for the flow of AS and the other for the flow of toothpaste and its various dilutions with AS. The microfluidic mixer has been fabricated as a layered design, incorporating a middle layer created through the utilization of SLA 3D printing technology (LF-SLA) on a Formlabs Form3 3D printer. For this purpose, a flexible transparent resin with a shore hardness of 80A, specifically the Formlabs' Flexible 80A resin, was employed. To enclose the microfluidic chip, transparent PMMA layers were employed on the top and bottom sides, which were cut using a CO_2 laser CNC machine, MBL 4040RS (Minoan Binding Laminating, Belgrade, Serbia). For simulation purposes using COMSOL, parameters were obtained from the datasheets of both the toothpaste and AS. All parameters that were not available in the datasheets, such as particle size, density, viscosity, etc., were measured in the laboratory to ensure accurate simulations. During the experiments conducted on a real microfluidic mixer, observations of covarine particles were made using an optical profilometer. By combining experimental data from microfluidic chips with computational simulations, researchers can gain a more comprehensive understanding of the behavior of covarine particles, elucidating their interactions with saliva and the formation of microfilms on the enamel surface**.**

O.S.22.

Driving nanohybrid synthesis and hierarchical assembly at interfaces with surface chemistry anisotropy

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Morphological and surface chemistry anisotropy of certain nanomaterials can permit colloidal modification strategies which target specific interfaces. Colloidal modification of specific nanoparticle interfaces can provide a chemical environment that favors the nucleation and growth of other materials at the modified interface. For example, growth of semiconductors such as In_2S_3 [1,2] at the interface of tube- and disc-like nanomaterial templates can result in nanomaterial hybrids with drastically improved photocatalytic properties, while the surface chemistry and solvent dispersibility of the template is maintained. Layered materials with charged basal surfaces are particularly well-suited for controlling the crystal growth habit of a number of different materials, and the charge of the template can also introduce ionic selectivity to the function of the material [3,4]. Furthermore, the surface chemistry of edge and basal surfaces can dictate the outcome of how such anisotropic particles organize at liquid-vapor interfaces. Thus, perspectives on how such anisotropic modification strategies can be used to influence the hierarchical structure of assemblies formed at the interface of a laser-driven microbubble are presented, towards the directed hierarchical assembly of functional nanomaterials at interfaces[5,6].

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O.S.23.

Mechanical strength and impact toughness of additively manufactured SA508GR.3 steel for nuclear reactor applications

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Recently, Additive manufacturing (AM) of SA508 Gr.3 steel has been considered as one of potential manufacturing candidates for the reactor pressure vessel (RPV) of small modular reactor (SMR) due to excellent mechanical strength and fracture toughness as well as complicated shapes by AM. In this paper, SA508 Gr.3 used for reactor pressure vessel (RPV), a safety-critical nuclear component, was additively manufactured by both direct energy deposition (DED) and powder bed fusion (PBF) and the mechanical properties were evaluated. As a result of the baseline test, the yield strength of the as-built SA508 Gr.3 was improved by ~90 % compared to the ASTM requirement (345 MPa), and the elongation and impact energy was within the error range compared with commercially available as cast SA508 Gr.3 steel. From the experimental results, we showed the applicability of both additive manufacturing technologies which are DED and PBF to fabricate nuclear parts.

O.S.24.

Synthesis and luminescent properties of ZnO-polymer nanoparticles

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Polymer nanocomposites obtained by the incorporation of inorganic nanoparticles into polymer environments have attracted increasing attention in last years. These materials demonstrate improving physics-chemical properties, that make them suitable for a wide range of applications. Zinc oxide nanoparticles are widely used in the different branches of science and technologies, such as medicine, pharmaceutics, cosmetic, energy, micro and optoelectronics, solar cells, photocatalysis, food, chemical industry, etc. Besides that, zinc oxide also can be used as luminescent optical material. However, zinc oxide own photoluminescence (PL) is mainly located in the UV range that makes it unsuitable for lightning applications. Creating of various polymer environment can be used to obtain defect-induced visible light PL from materials based on the zinc oxide. In this work, we study the obtaining conditions, physical and chemical characteristics of polymeric nanocomposites formed between zinc oxide (ZnO) nanoparticles and poly(vinyl alcohol) (PVA). For the synthesis of an oxide-polymer composite based on ZnO and PVA, we proposed a technique that includes 3 stages: precipitation, chemisorption and thermolysis. Obtained “ZnO - polymer” nanoparticles have been analyzed by XRD, FTIR, SEM and DTA/TG. According to X-ray and thermal analysis, single-phase zinc oxide is formed already at 500 °C. X-ray diffraction pattern shows that all the diffraction peaks can be assigned to hexagonal phase with wurtzite structure, space group (*P63mc*). According to SEM results, size and morphology of the nanoparticles have been analyzed. The average crystallite size and lattice strain were also studied by using Williamson-Hall method. The estimated crystallite sizes in synthesized samples ranged from 22 to 100 nm. PL emission of the investigated samples is observed in the wide spectral range from 350 to 800 nm. The PL spectra are complex and consist of two types of spectral details. There are narrow band in the 350 – 450 nm range and wide band in the 430 – 800 nm range. The relative intensities of these bands depend on the concentration of polymer. The narrow UV band corresponds to the well-known ZnO exciton emission. The wideband visible emission is complex and consists of several spectral components caused by electron transitions in defect-induced emission centers related with “ZnO – polymer” interaction. Origin and structure of these centers are discussed.

O.S.25.

Wireless electrochemical processes on two-dimensional materials

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Bipolar electrochemistry (BPE), a process that creates asymmetrical reactivity on conductive surfaces wirelessly, holds significant importance in various fields such as analysis, and materials science[1]. Although the fundamental concept has been familiar to chemists for an extended period, it has recently garnered increased interest, particularly in relation to micro- and nanoscience. The current research discusses the exploration of bipolar electrochemistry on low-dimensional materials, specifically focusing on graphene, and the generation of electrochemiluminescence (ECL) in confined free-standing 2D spaces, such as surfactant-based air bubbles (Figure 1)[2]. The study demonstrates the key advantages of a 2D environment, enabling wireless activation of ECL at lower potentials, making it compatible with (bio)analytical systems.[2] The ultrathin walls of the bubbles act as a host for trapped and dispersed graphene sheets, serving as bipolar ECL-emitting electrodes. The potential required for ECL generation is significantly reduced due to nanoconfinement. Additionally, a novel approach for controlling the dispersibility and conductivity of graphene sheets is introduced, utilizing a quasi-2D reaction layer in an original bipolar electrochemistry setup[3]. This method allows for the precise control of reduced graphene oxide (rGO) properties by adjusting the field strength and exposure time. The resulting rGO sheets with engineered conductivity/dispersibility are used in organic battery applications and, at higher potentials, serve as catalysts for hydrogen evolution reaction with performance comparable to bulk Pt.

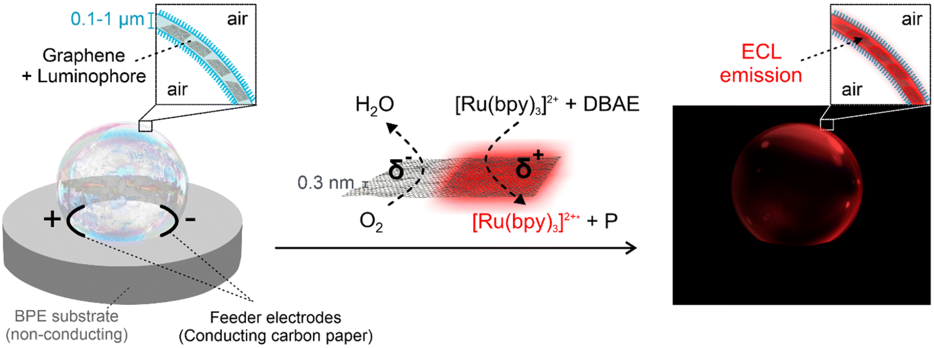

Figure 1. *Illustrative representation of ECL in a soap bubble's thin layer using graphene sheets as bipolar electrodes.*

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O.S.26.

Influence of sintering conditions on microstructure topology in YSZ ceramic

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Grain boundaries (GBs) play an important role in different processes, such as grain growth and recrystallization, segregation, corrosion, deformation, damage and oxidation. They influence also electrical properties of the material. Due to the important role of GBs, it is of high interest to investigate grain boundary character distribution in crystalline materials. Zirconia ceramics is a well-known material utilized in a wide range of applications in materials science, such as thermal barrier coatings, sensors and solid electrolytes. The motivation for understanding the microstructure of yttria stabilized zirconia (YSZ) sinters comes from the requirement to improve their performances as solid oxide fuel cells (SOFCs) used as a potential power source in automotive industry. Yttria stabilized zirconia with high ionic conductivity and chemical resistivity seems to be an ideal material for SOFCs applications. The most frequently used ceramic for SOFC electrodes is the zirconia solid solution with 8 mol.% of Y_2O_3. Such a concentration of stabilizing cations gives the highest ionic conductivity of the electrolyte measured by electrochemical impedance spectroscopy (EIS). Prediction and calculations of electrical properties of polycrystalline zirconia solid solution require the proper knowledge of its microstructure, preferably in three dimensions. To determine the GB conductivity precisely, the knowledge of the GB density, the GB plane distribution (GBPD) as well as the GB character distribution (GBCD) is a matter of great importance. Analysis of GB networks based on 3D data delivers such data.When analysing populations of boundary planes in YSZ sinters by use of three dimensional electron backscattered diffraction (3D EBSD), a development of texture at relative lower sintering temperatures (in the range of 1500°C and 1550°C) has been observed. In the YSZ samples sintered in this temperature region, boundaries having [001] planes were over-represented contrary to the apparently weak evidence for over-representation of such boundaries in the zirconia ceramics sintered above 1550 °C.

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O.S.27.

Borophene oxide with tuned chemical structure for energy related study

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Borophene and its derivatives, as the youngest members of 2D materials family, are still at their early stage of research – this is related to the complexity of their structure and hence not fully explored and controlled synthesis techniques. Therefore, in order to explore their practical applications the fabrication routes should be explored in details. In our study we show the new approach to borophene oxide fabrication via the improved Hummers method which is in the next step treated at different temperature in hydrogen flow. The chemical environment of obtained borophene derivatives formed during the process are monitored via XPS, where the B-O/B-B bonding ratio is tuned and the formation of the B_2O_3 phase is found. What is more, higher temperature treatment induced defects/holes clearly observed in TEM analysis serving as active sites in e.g. the electrocatalytic reaction. It was found the borophene treated with hydrogen at 600°C was revealed as a robust electrocatalyst in oxygen evolution reaction (OER) with low overpotential – 481 mV, Tafel slope of 100 mV/dec and electrochemical active surface area (ECSA) of 276 cm^2. The ex situ spectroscopic study (XPS) of the sample before and after electrochemical test provided insight into active intermediates taking part in the OER mechanism. Therefore, we believe this material deserves to be fully explored in different energy related esearch.

O.S.28.

Contrasting bulk to superlattice claddings in interband cascade lasers

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Interband cascade lasers (ICLs) are mid-infrared emitting devices used for e.g. environmental sensing. Compared to other lasers, ICL perform very well in the 3-7 µm wavelength range and show the lowest threshold current densities and also higher characteristic temperatures than regular type-I diode lasers. Both are needed for portable devices operating in continuous wave (CW) regime at room temperature. We have grown ICLs emitting at 5 µm with bulk AlGaAsSb and InAs/AlSb superlattice claddings (Figure 1a) and we characterize and contrast the lasers' figure-of-merits. P-I-curves (Figure 1b) and temperature dependent measurements (Figure 1c) show improved device operation for ICLs with bulk claddings compared to the usually employed superlattice claddings. The improvement of threshold current density can be attributed to achieved improvement of the optical confinement [1]. Higher thermal conductivity of the bulk compared to superlattices (7 W/m·K to 1-3 W/m·K, respectively) [2] and bigger characteristic temperature contribute to enhancement in operation in CW.

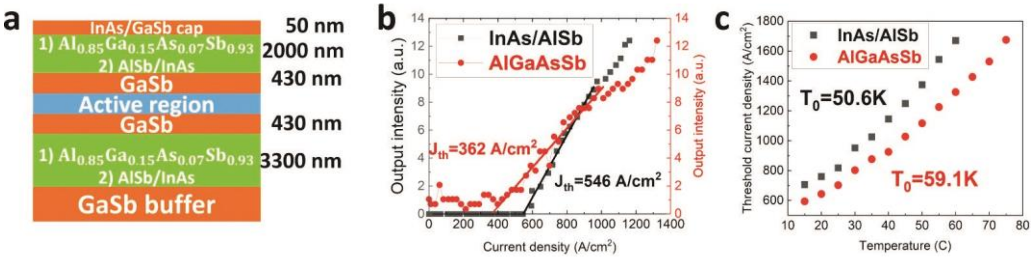

Figure 1. *a) Layer structure with 1) bulk and 2) superlattice cladding b) P-I characteristics c) Characteristic temperatures*

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O.S.29.

High-entropy alloys with the supersilent microstructure

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High-entropy alloys (HEAs) represent novel metals-based materials with complicated microstructures, where at least five different chemical elements, all in majority concentrations, are mixed on a simple crystal lattice. The complex atomic and phase structure, together with the choice of the elements and their concentrations, determine the physical properties (magnetic, electric and thermal) of the HEAs, which are usually not just the compositional average of physical properties of the constituent phases. Here we present the HEA material which possesses a combination of excellent magnetic softness and vanishing magnetostriction. It is a ferromagnetic high-entropy alloy system $AlCoFeNiCu_x$ (X = 0.6–3.0) [1]. The alloy develops a multiphase (up to three phases) composite microstructure that is further nanostructured on the 10 nm scale. Magnetic softness of the alloy originates from the exchange-averaging of magnetic anisotropy, while vanishing magnetostriction coefficient of the $AlCoFeNiCu_{2.0}$ alloy results from its microstructure, where the magnetostrictions of different signs exactly compensate each other at particular volume fractions. Therefore, those HEAs are expected to find the applications as supersilent (inaudible to a human ear) materials.

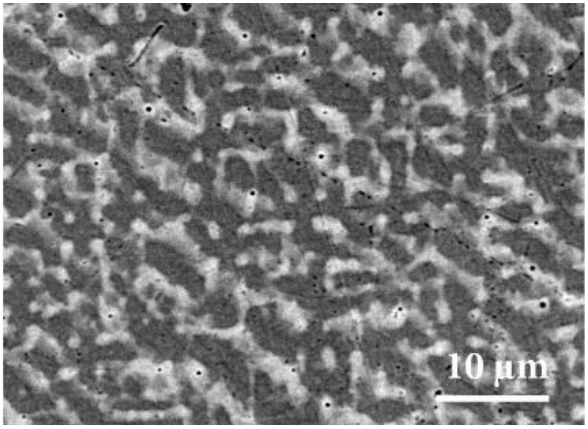

Figure 1. *BS SEM image of the AlCoFeNiCu HEA material, microstructure of two-phase magnetically diverse high-entropy alloy.*

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O.S.30.

Fracture peculiarities of shape memory alloy at various frequencies of fatigue loading

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Shape memory alloys are widely used functional materials thanks to their inherent shape memory effect and pseudoelasticity. Their application is determined by the temperatures of the beginning and the end of direct and reverse phase transformations and their ability to deform during these transformations retaining unique properties under the influence of specific mechanical loads. The influence of the fatigue loading frequency *f* in the range from 0.1 to 10 Hz for nitinol samples ($Ni_{55,8}Ti_{44,1}$) with a diameter of 1.5 mm during tests in air with a stress control at the stress ratio of 0.1 on its fatigue indicators was studied. The shape memory alloy was in a state of stable austenite at the test temperature of 24±1^{O}C. From the loading-unloading diagrams of the samples, which changed their shape and slope as the number of loading cycles N increased, the dissipated energy W_{dis} in each cycle was estimated. Its maximum value W_{dis}^{max}, which was achieved during the tests, decreased with increasing f. Loading frequency significantly influenced the value of maximum deformation $\boldsymbol{\varepsilon}_{\mathbf{max}}$, recorded before the sample's fracture, and residual deformation ε_{res}, evaluated after their fracture; these parameters decreased as f increased. The value $\varepsilon_{max} - \varepsilon_{res}$ characterizes deformation caused by elastic energy accumulated in the sample during the loading and released at the moment of its fracture. Its dependence on f is similar to those for W_{dis}^{max}.The fracture features of the samples tested at loading frequencies of 0.1, 1.0, and 10 Hz were fractographically analysed. It is shown that in the stress control mode, fatigue striations were detected both at the initiation stage and the stage of subcritical crack growth, regardless of the loading frequency of the samples. The crack closure effect caused by the contact of conjugated fracture surfaces significantly complicates the detection of such small fracture elements as fatigue striations. A fractographic feature of nitinol is a variable step of fatigue striations in a loading cycle. It is explained by shifts along different planes at the crack tip caused by the direct and reverse structural-phase transformations in nitinol under the action of stresses.

O.S.31.

Sodium-ion storage mechanism investigation of vine shoots-derived hard carbon

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Sodium-ion batteries (SIB) have emerged as a promising alternative to the widely used lithium-ion technology since sodium is an abundant element and has similar properties to lithium. Of all carbon materials, relatively cheap, non-toxic and safe, biomass-derived hard carbon (HC) has been proven suitable for sodium storage, making it a promising negative electrode option for SIBs. Although the mechanism of this process was thoroughly investigated by various authors, it still remains vague to date. To contribute to the understanding sodium storage mechanism, a series of biomass-derived hard carbon materials was prepared by a simple and efficient method involving carbonization of vine shoots at various temperatures from 700 to 1600 °C. Structural characterization (XRPD and Raman measurements) and charge/discharge tests in half-cell configuration indicate a three-step Adsorption-Intercalation-Pore Filling mechanism for Na-ions in HC. The degree of graphitization increases with carbonization temperature, which can be correlated with the decrease of the capacity corresponding to the sloping region (high potential) and the increase of the capacity related to the plateau region (low potential). However, the plateau capacity increases very rapidly, indicating that the ultramicropores are most likely filled at this time. Different capacity *vs.* current rates trends of HC, measured for different carbonization temperatures, can be explained by the relative contributions of individual steps in the total charge storage mechanism.

Acknowledgements: This research was supported by the NATO Science for Peace and Security (SPS) Programme under grant G5836-SUPERCAR. Authors gratefully acknowledge the financial support from the bilateral project Montenegro-Slovenia "Biomass-derived carbons as anodes in sodium-ion batteries."

O.S.32.

Core issues of the sol-gel process for designing a high-quality polyanionic $Na_4Fe_3(PO_4)_2(P_2O_7)$ phase

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When one mentions Na-ion batteries, the first thought that comes to everyone's mind is the prospect of replacing powerful and non-sustainable Li-ion technology. With important discoveries and breakthroughs, many research teams raised the bar for Na-ion batteries research, demonstrating that once-considered unreachable performances are still possible. In the rush for the most appropriate sodium-ion electrodes, different polyanionic structures, even exotic ones, have been rapidly developed. In this contribution, a series of new polyanionic compounds with different ratios of the mixed-phosphate phase ($Na_4Fe_3(PO_4)_2P_2O_7$-NFPP) and sodium pyrophosphate phase ($Na_2FeP_2O_7$-NFP) was developed by varying the citric acid to Fe ratio, with the aim to understand the key factors responsible for the formation of the mixed-phase and its interrelation with the secondary pyrophosphate phase, $Na_2FeP_2O_7$. Through the characterization of samples (as evidenced by XRD, FTIR, TG/DTA and CV) and careful observation of suspension color under different stages of synthesis procedures, some crucial issues regarding the reaction path of NFPP sol-gel have been elaborated. In particular, the role of sol-gel synthesis parameters (the amount of citric acid and sucrose, pH solution, etc.) in the design of the high-quality mixed polyanionic phase will be addressed. Special attention is focused on identifying NFP admixture in the $Na_4Fe_3(PO_4)_2P_2O_7/Na_2FeP_2O_7$ and adjusting the phase composition to target the final electrochemical properties. Results can be inspiring for exploring the broad family of polyanionic compounds in light of their synthesis and tailoring sodium storage properties.

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O.S.33.

Surface melting of single Sn and Sn-Ge nanoparticles

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Despite previous studies, understanding the fundamental mechanism of melting metal and alloy nanoparticles remains among the major scientific challenges of nanoscience. Herein, the kinetics of melting of single Sn and Sn-Ge nanoparticles was investigated using *in situ* TEM heating techniques with a temperature step of up to 0.5K. The nanoparticles were formed by PVD deposition of Sn and Sn-Ge island film on SiN membrane of a MEMS chip. The mass thickness of the films was 10 nm and the deposition was performed in a vacuum of $2x10^{-7}$ Torr on the substrate at room temperature. For the characterization of nanoparticles, we used FEI Titan G2 cubed 60-300 probe Cs-corrected TEM operated at 300 kV and 80 kV, equipped with a GIF Quantum SE System (Model 963, Gatan). The microscope was fitted with a double-tilt MEMS-based heating holder (Wildfire D6 from DENSsolutions) for *in situ* studies. We revealed the surface pre-melting effect and assessed the density of the surface overlayer on 47 nm Sn particle using a synergetic combination of high-resolution scanning transmission electron imaging and electron energy loss spectral imaging. Few-monolayer-thick disordered phase nucleated at the surface of the Sn particle at a temperature ≈25K below the melting point and grew into the solid core (up to a thickness of ≈4.5 nm) with increasing temperature until the whole particle became liquid. We found that the disordered overlayer was not liquid but a quasi-liquid one with a density intermediate between that of solid and liquid Sn. The nucleation and growth of the quasi-liquid layer as well as its density were not uniform over the surface of the nanoparticle, which is likely due to a surface anisotropy of Sn nanoparticles. The kinetics of melting Sn-Ge hybrid nanoparticles will be presented and discussed in the second part of the talk.

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O.S.34.

Design of superhydrophobic films with functional nanofillers

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The development of new types of superhydrophobic surfaces is becoming more and more relevant, and ways to improve their properties are provided by the use of new materials, nanoparticles and polymers. This work proposes two approaches to the design of superhydrophobic composite coatings: (i) by acid hydrolysis/condensation of TEOS and (ii) catalytic crosslinking of PDMS by Sylgard 184. The use of nanofillers of different structure allows one to achieve a combinationof the required parameters: low surface energy, micro- and nano-roughness and hierarchical multiscale. The fumed SiO_2 and MWCNT initial and modified with poly(dimethylsiloxane) (PDMS-100 and 1000) with a concentration from 5 to 20 % wt. were used as nanofillers. The structure and textural parameters of nanofillers were characterized by ASAP, SEM, FTIR and Raman methods. The fillers have a high S_{BET}: pure MWCNT - 190 m^2/g, MWCNT/PDMS ~ 155 m^2/g; fumed SiO_2 - 296 m^2/g and SiO_2/PDMS 166-218 m^2/g. The characteristic bands of MWCNTs, D band (defect) at ~ 1320 cm^{-1}, G band (graphite band) at ~ 1610 cm^{-1} and G'-band (D overtone) at ~ 2630 cm^{-1} were observed in Raman spectra. The intensity ratio of G band to D band (AG/AD) is used as an indicator of the amount of defects in MWCNTs. FTIR was also used to analyze the formation of a film deposited on a glass substrate and control its post-modification by HMDS. In addition, the relationship between micro- and nano-roughness with hydrophobic properties and apparent surface energy was analyzed for synthesized hybrid films. The hydrophobic properties of the synthesized hybrid coatings, determined by advancing and receding contact angle (CA) of water on the sample surfaces were measured using the CA meter GBX (France), correspond to the parameters of superhydrophobicity, the CA was greater than 150 deg. for films modified with nanofillers.

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O.S.35.

Wear resistance enhancement of nanocrystalline surface layer of low-alloyed steel produced by multidirectional severe plastic deformation

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A nanocrystalline surface layer was fabricated on a low-alloyed steel using mechanical-pulse treatment (MPT) with different severe plastic deformation modes, unidirectional and multidirectional one. The microstructural features in the treated surface layer were characterized using scanning electron microscopy and transmission electron microscopy observations. The grain size is about 10 nm in the top surface layer. The microhardness of the top nanocrystalline layer is about 5 and 5.3 times of that of the matrix at using unidirectional and multidirectional severe plastic deformation, respectively. The tribological behaviour of the nanocrystalline surface layer was investigated under dry conditions. The surface layer with a nanocrystalline structure formed by MPT using different deformation modes was characterised by improved mechanical properties and wear resistance compared with those of the untreated or heat-treated steels. Inducing multidirectional deformation during the MPT resulted in a decrease in the grain size and an increase in the depth and microhardness of the surface layer due to it facilitating the generation of dislocations compared to those formed under unidirectional deformation. The favourable surface topography parameters providing the highest wear resistance of the steel were obtained at MPT using multidirectional deformation.

O.S.36.

Jute post-industrial waste as carbon nitride support in photocatalytic degradation of textile dyes under simulated solar light illumination

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Urea-based graphitic carbon nitride (g-C_3N_4) is thermally exfoliated at 500 °C in the air atmosphere, and nano-carbon nitride (n-C_3N_4) is obtained. While optical properties are assessed using UV/Vis DR spectroscopy, structural and morphological parameters of two materials are obtained using XRD, TEM, and FTIR. Flat-band potentials were determined from Mott-Schottky plots, and combined with corresponding band-gap energies, to estimate conduction and valence band potentials of both materials. Photocatalytic efficacy of both semiconductors in photocatalytic degradation of three textile dyes under simulated solar light irradiation is compared, with the conclusion that n-C_3N_4 expressed higher photocatalytic ability in the studied systems. Finally, in order to provide reusability of the semiconductors in multiple consecutive photocatalytic cycles, both photocatalysts were drop-coated on the jute-based post industrial waste. Reusability of jute-n-C_3N_4 material is probed in three consecutive photocatalytic cycles, and the obtained results showed that this material can have a future in solving real-life environmental problems.

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O.S.37.

Solidified wastewater treatment sludge as a prospective supplementary cementitious material for processing pervious concrete pavements

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Waste and recycled materials have recently been used in the construction industry in order to reduce environmental pollution. This study was focused on the possibility of using of solidified wastewater treatment sludge, Neutral, in the production of lightweight pervious concrete pavers (LWPCP). For this purpose a series of four LWPCP materials mixed with Neutral in different amounts (0, 10, 20 and 30 wt.%) were prepared, characterized and their physical and mechanical properties were analysed. It is shown that partial replacement of cement with Neutral in LWPCP resulted in the decrease of all mechanical properties, ranging between 3.91 and 5.81 MPa for compressive strength and 0.97 to 1.23 MPa for flexural strength. The investigated materials showed a value higher than 3.5 MPa, which was defined as the lowest compressive strength in the range of pervious concrete properties. The addition of Neutral slightly decreased the bulk density of the materials and increased water absorption. This could be explained by the reduction in hydration products that would fill in the micropores of the materials, since Neutral showed no pozzolanic reactivity. Pore sizes in the tested materials were in accordance with the results measured on concrete.

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O.S.38.

Chitosan: From food waste to high value transformative healthcare solutions

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Chitosan, a linear, cationic copolymer, produced from the deacetylation of chitin found in fungal cell walls and crustaceans, with the latter being a major waste product of the fishing industry, is gaining momentum in efforts towards sustainable health care. Chitosan has been designated ‘generally recognized as safe (GRAS)’ by the FDA and is approved for use in dietary supplements as well as applications in wound dressings and gels, but ambition goes well beyond this and includes formulations of intelligent stimuli responsive scaffolds for tissue engineering and advanced drug delivery systems. In this talk, we will present key findings from our studies ranging from chitosan purification and endotoxin removal [1], biodegradation and biocompatibility [1-3], to novel injectable, implantable [4] and recently developed transdermal formulations for drug delivery of both small drug molecules and biologics.

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O.S.39.

Prospects for the search for biocompatible materials in pathology

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Biomineralization is the formation of minerals by living organisms under the conditions of formation and growth of biominerals from a saturated aqueous solution with the participation of an organic matrix of cellular origin. Ectopic calcification is defined as the abnormal biomineralization of soft tissues. The research was conducted on the material obtained from 270 patients. The study was approved by the ethics committee of the Medical Institute of Sumy State University (Protocol No. 3/6, 06.07.16). The basis of the clinical-morphological, immuno-histochemical, and physicochemical studies was 70 cases of aortic calcifications, 40 samples of mineralized aortic valves, 74 cases of malignant thyroid tumors, 20 cases of prostatolithiasis, 20 cases of gallbladder calcifications, 5 cases of pancreolithiasis, 10 cases of sialolithiasis and one a case of pathological biomineralization of the eye.As a rule, ectopic deposits of calcium compounds are represented by calcium phosphate salts, mainly hydroxyapatite. A detailed study of the biomineralization processes of soft tissues will allow a new look at many established ideas about this process. New knowledge obtained during research stimulates the development of many promising directions in medicine, molecular biology, and the biotechnology of new materials. A promising research direction is the selection of new biocomposite materials from pathological tissues. Physical prototypes of this material arise at different stages of the development of biomineralization processes. For example, the mineralized fibers of the wall of the porcelain gallbladder have extraordinary mechanical parameters (durability, adhesion, hardness), and the mineralized tissues of the aorta and valves show exciting data. Such materials have a significant advantage in that they do not cause rejection reactions in the body and are entirely biocompatible.The prospect of finding biocomposite materials will reveal the relevance and further development of biomineralization studies in living organisms at the current level.

O.S.40.

Biomineralization towards synthesis of biomaterials

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A biological system has unique strategies to synthesize various inorganic materials beneficial for their living. Although various strategies have been developed for synthesizing functional materials, conventional synthetic methods need harsh conditions including high temperature/temperature, caustic reagents, and organic solvents. By learning from the nature and mimicking biomineralization, various materials can be synthesized under benign conditions.[1-3] The biomimetic methods have been successfully applied to even living cells, including microbials and mammalian cells.[4-10] The coating or encapsulation of single cells with inorganic materials have drawn great attentions because the manipulation was beneficial for protection of the cell from foreign aggressions and modification of cell behavior. On the other hand, bone-like materials have been synthesized in a hydrogel by emulating a slow mass transfer in a biological system.[11-15] Different from aqueous solution, ion diffusion is extremely slowed in a hydrogel, which is beneficial for regulating the crystallization. In this presentation, various biomimetic strategies will be discussed, which is beneficial for synthesizing biomaterials under biocompatible conditions.

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O.S.41.

Heterogeneous hierarchical self-assembly forming crystalline nanocellulose - $CaCO_3$ nanoparticle biocomposites

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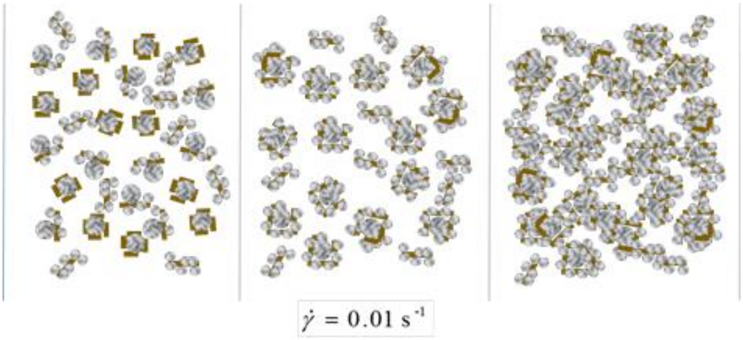
Following earlier work studying the heterogeneous interaction between micro nanofibrillated cellulose (MNFC) and calcium carbonate ($CaCO_3$) particles in aqueous suspension when placed under specific conditions of induced stress initiated by applied strain at ultralow shear rate (0.01 s^{-1}), we newly observe a similar interaction between crystalline nanocellulose (CNC), *i.e.* cellulose crystals resulting from having the amorphous cellulose and hemicellulose components removed from plant fibres, with fine chemical-free $CaCO_3$ nanoparticles. The suspension displays an intrinsic gel-like state, and heterogeneous adsorption occurs. In contrast to the earlier work the sequential processes in the case of similarly sized CNC and $CaCO_3$ nano particles result in compound particle self-assembly leading to multi-level hierarchical structures depending on relative species size and concentration ratio. Depending on whether CNC or $CaCO_3$ particles are in excess, the structural assembly bonding occurs through CNC-CNC hydrogen bonding or $CaCO_3$-$CaCO_3$ autogenous flocculation, respectively. Control of the hierarchical composite structure bonding morphology in this way provides for novel complex composite materials, both alone and potentially in combination with other polymeric species, expressing dual or either single mineralic or cellulosic surface properties. Compatibility as functional filler is, therefore, designable across a broad range of natural polymeric materials for use, amongst others, in industrial processing, manufacturing, agricultural and pharmaceutical applications.



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O.S.42.

Application of nanomaterials for the design of immunosensors

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The rising significance of health care and clinical diagnosis has drawn considerable attention to the increasing demand for analytical instruments that are highly sensitive and selective to biomarkers of interest. An immunosensor is a specialized type of biosensor that is designed to register the interaction between an antibody and an antigen on the surface. The impact of nanoscience and nanotechnology on the advancement of analytical systems has been steadily increasing. Some challenging bioanalytical problems, such as sensitivity, specificity, and optimal linear range can be resolved by electrochemical and optical immunosensors based on noble metal and metal oxide nanoparticles [1-4]. This presentation will review the most commonly used methods for modifying noble metal and metal oxide nanoparticles by biomolecules. Additionally, the application of nanoparticles to enhance the analytical signal of immunosensors will be discussed focusing on recently developed strategies for the ultrasensitive detection of hormones, cancer, and osteoarthritis biomarkers.

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O.S.43.

Neural cells response on femtosecond laser-induced 3D scaffold

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Recently, femtosecond laser-induced structures co-called laser-induced periodic surface structures (LIPSS) were well introduced as a tool for modification of medical implants instead of famous method- Sandblasted, large grit, acid-etched implant surface (SLA) [1]. Advantage technology of LIPSS – highlyregular LIPSS (HR-LIPSS) provided substantial improvement of control and speed over large surface area and path the way from laboratory to industry [2]. Despite the tremendous importance of growing neural cells for humans, the study of impact of laser modification on neural cells has never been realized. In the present study, by exploiting femtosecond laser pulses we produced novel complex 3D structures. The 3D structures consist of periodic micropillars surrounded by holes each corner drilled through thinplate of Ti. Micropillars are also covered by nanostructures HR-LIPSS. We expect that such 3D scaffold will perfectly affect neural cells, their differentiation and proliferation. Preliminary results showed that our structure allowed proliferation of neurons, glia cells and both celllines seeded in co-culture. Moreover, we found that both cell types, analyzed by Scanning Electron Microscope (SEM), were able to adhere on the 3D structured scaffold, showing a well-organized cytoskeleton and a typical shape. In conclusion, our results are very encouraging and suggest the 3D modified scaffold Ti surface couldbe a promising tool to prepare medical implants.

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O.S.44.

Macrophage membrane-coated lipid nanoemulsions as biomimetic carriers of specialized pro-resolving lipid mediators for targeting atherosclerotic plaque

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Atherosclerosis (AS), a systemic disease characterized by a chronic inflammatory process and lipid deposition in the arteries walls, is the major cause of cardiovascular diseases. There is evidence that chronic inflammation observed within AS lesions results, at least in part, from failed inflammation resolution. This process is actively controlled by specialized pro-resolving lipid mediators (SPMs) that include separate families of molecules such as lipoxins, resolvins, protectins, and maresins. We aimed to develop advanced targeted therapies based on nanoparticles to mitigate the inflammatory process associated with AS. To this purpose, we designed and produced biomimetic nanocarriers comprising a cocktail of SPMs-loaded lipid nanoemulsions (LN) covered with macrophage membranes (Bio-LN/SPMs). We found that the developed Bio-LN/SPMs retained, on their surface, the macrophage receptors involved in cellular interactions and the "marker of self" CD47, which impeded their recognition and uptake by other macrophages. The binding of Bio-LN/SPMs to the surface of endothelial cells (EC) and smooth muscle cells (SMC) was facilitated by the receptors present on the macrophage membranes and partly by SPMs receptors. Moreover, Bio-LN/SPMs proved to be functional by reducing monocyte adhesion and transmigration to/through activated EC and stimulating macrophage phagocytic activity. After intravenous administration, Bio-LN/SPMs accumulated in the aorta of ApoE-deficient mice at the level of atherosclerotic lesions. Together, these results indicate that the newly developed Bio-LN/SPMs represent a reliable targeted nanomedicine for inflammation resolution in atherosclerosis.

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O.S.45.

Phage-delivering injectable gum Karaya-based hydrogel for the treatment of *S. aureus* infections

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Increasing bacterial resistance causes a threat to the healthcare system and millions of people worldwide since multidrug-resistant bacteria (MDR) with resistance to conventional antibiotics have become more frequent in infected wounds. An alternative mindset must be exploited to overcome such a threat. Bacteriophage (phage) therapy is one of the many options for battling resistant bacteria. Phage therapy is established because phage (virus) targets only a specific bacterial strain. Phage lyses bacterial cells and replicates to eliminate even heavy infection without unwanted side effects seen in antibiotics use. However, phages must be effectively delivered to the wound site using a suitable carrier. This work focuses on developing and preparing gum Karaya-based injectable hydrogels in various concentrations (3 – 3,5 wt.%) that ensure phages biostability during the application, storage, and optimal environment for moist wound healing. GK hydrogel was enriched with polyvalent phage that targets *S. aureus* strains. The biostability of this advanced material was tested using the double agar method, which proved phage activity and antibacterial properties against MRSA. These tests proved the biostability of the hydrogel after three months of experiments where phage reached a concentration above $1 \cdot 10^8$ PFU/ml, which is recommended for the treatment of infected wounds. This hydrogel was also tested in terms of morphology, phage visualization, and physiochemical properties (water sorption, hydrogel degradation), where samples remained stable over a month with a weight loss accounting for 25 – 30 wt.%. Based on the results, injectable GK-based hydrogels can become a suitable carrier for phages with long-term storage stability and subsequent application on *S. aureus* infected wounds while supporting the wound healing process.

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Poster Presentations

P.S.1.

Influence of metal selection and catalyst pretreatment on the aldaric acid dehydroxylation process

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Metal catalysts play a vital role in the field of chemical synthesis and have been extensively utilized for the conversion of various materials into target chemicals. Their ability to accelerate reaction rates and promote selectivity makes them indispensable in many industrial processes. In particular, the selective conversion of biomass-derived compounds to valuable chemicals is of great interest due to the growing demand for sustainable and renewable resources.

In this study, our desired target chemical was adipic acid, and we aimed to produce it from a biobased source, specifically aldaric acid. Various catalysts were tested, including different metals supported on different materials such as NiMo/γ-Al_2O_3, Pt/γ-Al_2O_3, Ru/SiO_2, Rh/SiO_2, Ni/SiO_2, Pt/SiO_2, Ru/C, Rh/C, Ni/C, Pt/C, Re/γ-Al_2O_3, Re/SiO_2, and Re/C. Additionally, different solvents, including water, methanol, and ethanol, were examined to determine the most environmentally friendly reaction conditions.The results indicated that water, although considered the most environmentally friendly solvent, was not suitable for the selected reaction. Methanol, on the other hand, emerged as the most favorable solvent. Among all the catalysts tested, only rhenium exhibited activity for selective dehydroxylation. Furthermore, the choice of support material proved to be crucial, as only rhenium on a carbon support yielded successful results. Catalyst pretreatment, particularly reduction, was also identified as a key factor in achieving high yields (up to 95 %) of the dehydroxylated product. Overall, this study provides insights into the importance of metal catalysts, solvent selection, support material choice, and catalyst pretreatment in the conversion of aldaric acid to adipic acid. The findings contribute to the development of more environmentally friendly and efficient processes for the production of target chemicals from biobased sources.

P.S.2.

Microsecond range pulsed DC plasma electrolytic oxidation on Ti and Nb

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Over the past few decades, plasma electrolytic oxidation (PEO) evolved as a valuable alternative to classical anodization for the formation of thick protective coatings on the surface of metals and their alloys. The presented research reports on the formation of oxide coatings on pure Ti and Nb substrates by microsecond pulsed PEO in commonly used sodium phosphate electrolyte, as these metals and their alloys have practical importance due to their abundance, stability and vast application potential. The formation process is monitored by real-time imaging and optical emission spectroscopy. Emission lines originating from Ti substrate are well resolved, while the appearance of high-resolution emission lines originating from Nb substrate in the visible range is reported for the first time. Subsequent characterization of formed oxide coatings on Nb shows that its roughness increases with PEO processing time, contrasting the case of Ti. It is observed that longer processing time of Ti substrate results in anatase-to-rutile phase transformation, while pseudohexagonal TT-Nb_2O_5 phase is present throughout the processing of Nb substrate. Photoluminescent and photocatalytic properties of obtained coatings are dependent on their morphology and phase composition i.e., on processing time.

P.S.3.

Basalt-based glass-ceramic composites

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Two series of glass-ceramic composites (basalt/mine tailings, basalt/basalt fibers) as well as one pure glass-ceramic were prepared from basalt rocks located in the SE part of Serbia (Lukovska Banja). Both composites contained 85, 90 and 95 wt.% basalt glass respectively. The basalt glass was obtained from initial melting of basalt at 1300 °C. In the present study, the crystallization process of basalt glass contained in the glass-ceramic composite, achieved by thermal treatment, was observed, and analyzed. The thermal treatment was done at 900 °C, 950 °C, 1000 °C and 1050 °C respectively, with the retention times of 1, 3, 6, 8 and 16 hours. It was found that the addition of mine tailings and basalt fibers caused a change in the density and microstructure. The study also showed that the best mechanical and structural characteristics of the examined glass-ceramics were attained at the temperature of 1050 °C, with the retention time of 1 hour. Additionally, structural and optical characteristics of the glass-ceramics were assessed.

P.S.4.

High-speed sintering of submicron-grained WC-8Co hardmetals

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WC-Co composites have an excellent combination of mechanical and chemical properties which provides their application in the metal cutting industry, aerospace, military, abrasive materials, coatings, *etc*. The variation of WC grain size (coarse, fine, ultrafine) and binder quantity (between 2-30 wt.%) promotes to development of a wide range of unique properties and potential applications of hard alloys. Till now, the maximum of fracture toughness and strength can be obtained for nanoscale or ultrafine hard alloys with WC grain size less than 0.1 µm. But retaining the submicron grain size during sintering is a challenge due to the high activity of nanoparticles. The work contains results of applications of two new approaches for high-speed densification of WC-8Co hardmetals powder compacts via controlled stress-strain state upon local heating: selective electron beam sintering (SEBS) and induction zone heating (IZH). The influence of the temperature gradient on the microstructure, phase composition and mechanical properties of the WC-8Co was studied. A distinctive feature of the SEBS process is the controlled stress-strain state by varying thermal stresses during local electron beam heating at different rotation speeds (0.1; 1.0; 2.5 mm/s) of a cylindrical powder compact. As a result, the sintering time of porous compacts to full density does not exceed 150 s. The experimental and calculated results indicate that the main requirement for obtaining well-sintered material is the shrinkage rate should be less or equal to the rate of thermal expansion of the sample segments subjected to repeated local heating. IZH process provided the study of the influence of the speed of movement (1-7 mm/min) of the porous sample in the narrow zone of induction heating. In this way, unique conditions of liquid-phase sintering were created, which ensure compaction to a fully dans state and do not lead to coarsening of the structure. The hardness of as fabricated hardmetals was in the range of 91–93 HRA, which is comparable to that of high-quality WC–8Co.

P.S.5.

Effect of laser powder bed fusion process parameters on the static recrystallization temperature of Inconel 625 superalloy

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Repeated cycles of melting and solidifying of the melt pools during the Laser Powder Bed Fusion (LPBF) process generate a high residual stress level in additively manufactured parts made of Inconel 625 superalloy. The stress level can be so high that recrystallization occurs during annealing despite no deformation. The aim of this work was to determine the recrystallization temperature of Inconel 625 manufactured by the various sets of process parameters using the LPBFmachines with the laser beam spot size equal to 35 µm (AYAS 120 LM) and 55 µm (SISMA MySint 100). After manufacturing, the samples were subjected to annealing in a temperature range of 900 to 1100 °C for 1 hour. This temperature range was chosen to cover both the static recrystallization temperature of cold-deformed Inconel 625 and that of the additively manufactured samples. The microstructure of the annealed samples was investigated by using light microscopy and scanning electron microscopy. The results of the study indicate that annealing within this temperature range can lead to recrystallization or not, depending on the LPBF process parameters applied. For example annealing at 980 °C for 1 h, which is commonly applied for stress relief annealing, the static recrystallization occurred in Inconel 625 LPBF manufactured by AYAS 120 LM and SISMA MySint 100 machines. Meanwhile, annealing at the same conditions did not result in recrystallization of the Inconel 625 LPBF samples manufactured using routine parameters recommended for EOS M290 machine with spot size equal to 100 µm. It was therefore determined that in Inconel 625 the recrystallization temperature is strongly influenced by the LPBF process parameters. Further studies are needed to gain a deeper understanding of how different process parameters affect the recrystallization behavior of Inconel 625, and thus to identify the optimal annealing conditions for LPBF manufactured components.

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P.S.6.

Hydrothermally activated vine shoots for carbon-based aqueous supercapacitors

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With 22711 tons, Montenegro produces a significant amount of grapes annually for both commercial and domestic purposes. Wooden biowaste that is left after grooming poses an environmental issue as it calls for an adequate management plan. This study investigates hydrothermal treatment as an efficient strategy to convert this abundant waste into a high-quality, carbon-based energy storage material. The synthesis starts with heating a water suspension of chopped vine shoots at 200 °C in a sealed hydrothermal reactor. The obtained hydrochar (HTC) is further carbonized at 700 °C under the Ar atmosphere with and without $ZnCl_2$ as an activator (AC700 and C700). In the end, both probes were washed with 1 M HCl and then with distilled water to remove the inorganic residues. For HTC and both AC700 and C700 products ultimate analysis, ash content measurements, and TGA/DSC analysis were performed. The activated hydrochar was lower in carbon content, probably due to significant ash. FTIR and XRPD analysis of the obtained carbons indicate low surface functionality and typical amorphous structure of carbon. AC700 and C700 samples were analyzed as electrode materials for supercapacitors in typical aqueous electrolytes. AC700 reached the specific capacity of 126 Fg^{-1} at 20 mV s^{-1} in 6 M KOH which makes it a promising candidate for use in energy storage systems.

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P.S.7.

MXenes based surface enhanced Raman spectroscopy sensor for the detection of drug metabolites

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$Ti_3C_2T_x$ 2D titanium carbide MXenes nanostructures with unique electrical and optical properties were discovered in 2011 by Yury Gogotsi and his research group [1]. Since then, the synthesis and characterisation of MXenes properties have been intensely studied. Up to date, it is reported that $Ti_3C_2T_x$ finds application in many areas, such as energy storage, photocatalysis, water purification, electrochromic devices, sensors, biosensors, SERS substrates, triboelectric nanogenerators [2,3]. This study focuses on the preparation of $Ti_3C_2T_x$ MXene films suitable for the design of surface enhanced Raman spectroscopy (SERS)-based sensors. It was discovered that such sensors could be applied for the detection of drug metabolites, and the dominant enhancement mechanism is chemical. Furthermore, theoretical modeling based on density functional theory (DFT) calculations using B3LYP/6311G++ functional determined that titanium had a major role in detecting drug metabolites.

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P.S.8.

ZnO/RuO$_2$ nanostructured composites with enhanced bifunctional photo-electro catalytic activity toward water splitting

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The demand for affordable and accessible catalysts to replace the expensive and scarce resourced platinum group metals (PGMs) has become increasingly vital. Since they combine different properties such as electrochemical activities, chemical and photochemical stability, non-toxicity, etc. ZnO-based materials have been examined for potential applications in electronics, opto-electronics, sensing in environmental applications as well as catalysis. This study focused on cost reduction of PGM materials by introducing RuO$_2$ as a substitute for Ru and decreasing the amount of RuO$_2$ through the incorporation of abundant and versatile ZnO. A composite of ZnO/RuO$_2$ in a 10:1 molar ratio was synthesized using a microwave proccessing of a prepcipitate. To enhance its catalytic properties, the composite was subsequently annealed at 300 and 600 °C. The physico-chemical characteristics of the ZnO/RuO$_2$ composites were analyzed using X-ray powder diffraction (XRD), Raman and Fourier transform infrared (FTIR) spectroscopy, field emission scanning electron microscopy (FESEM), UV-Vis diffuse reflectance spectroscopy (DRS), and photoluminescence (PL) spectroscopy. Furthermore, the electrochemical activity of the samples was assessed through linear sweep voltammetry in both acidic (0.1 M H_2SO_4) and alkaline (0.1 M NaOH) electrolytes. Remarkably, the ZnO/RuO$_2$ composites exhibited excellent bifunctional catalytic activity for hydrogen evolution reaction (HER) and oxygen evolution reaction (OER) in both types of electrolytes.

P.S.9.

Intrinsic point defects in $BaTiO_3$-based ceramics

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Intrinsic point defects, i.e., oxygen vacancies, might lead to exciting improvements in advanced ceramic materials' functional properties. For instance, lead-free piezoceramic $BaTiO_3$ decreases band gap width, increases relative permittivity, or improves its densification after introducing oxygen vacancies. In this work, $BaTiO_3$ (pure and Zr-doped) was densified very quickly by rapid pressure-less sintering to obtain dense ceramics with fine microstructure. Oxygen vacancies were later induced by employing annealing in various reducing atmospheres. The presence of oxygen vacancies in the lattice was confirmed by colour change of the samples, Raman spectroscopy, X-ray diffraction analysis, X-ray photoelectron spectroscopy, and electron paramagnetic resonance. The influence of oxygen vacancies on the functional properties of $BaTiO_3$-based ceramics was described in terms of dielectric and piezoelectric properties.

P.S.10.

Potential of applying the quadratic failure criteria for short carbon fibre-reinforced PET-G composite material used in additive manufacturing

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Short carbon fibres (SCF) have been introduced in additive manufacturing (AM) of polymer-based parts designed for moderate loadings. Alongside other influential parameters for the strength and stiffness of thus obtained composite materials, scientific papers in AM field emphasize the effect of raster angle (printing direction) applied. Consequently, this study considers the idea of comparing the yield strength values experimentally evaluated for plate specimens additively manufactured from SCF-reinforced PET-G filament applying different raster angles with theoretical tensile strength vs fibre orientation curves already known from Classical Lamination Theory (CLT) for continuous fibre-reinforced composite laminas. Among many failure criteria relevant to ductile isotropic materials, maximum distortional energy criterion (von Mises) is the most widely used. Thus, von Mises criterion is usually used for predicting the onset of yielding in isotropic metals. However, for anisotropic composite materials, such as thin plates made from continuous fibre-reinforced polymers, the use of von Mises failure criterion is not applicable. Therefore, quadratic interaction criteria (*e.g.* Tsai-Hill) are often proposed for such materials. In this study, Tsai-Hill quadratic interaction criterion is implemented in order to predict the onset of yielding (failure) of thin composite plates made from SCF-reinforced PET-G. The off-axis tensile test is used to experimentally evaluate the failure of test samples printed with different raster angles. Linear-elastic material behaviour model was determined by modulus of elasticity and the value of yield strength for each sample set (seven sets were observed, raster angle ranging from 0° to 90° with the increment of 15°). Obtained results suggest that Tsai-Hill quadratic interaction criterion can be considered as a potential candidate for criterion capable to predict the onset of yielding (failure) of thin composite plates additively manufactured from SCF-reinforced PET-G material.

P.S.11.

Olive mill waste towards carbon electrodes for aqueous supercapacitors

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Due to the complexity of olive mill waste, environmentally friendly management solution is needed. Hydrothermal carbonization (HTC) is a convenient method as it is suitable for the biomass with higher water content to avoid pre-drying. This study aims to investigate one-pot HTC synthesis as a management solution that would yield highly porous carbon which would be used as an electrode material for supercapacitors. The applied synthesis procedure included the hydrothermal treatment of olive mill waste at a constant temperature using different activating agents which yielded various hydrochar precursors. After carbonization of hydrochar at higher temperature under inert atmosphere, carbon materials with different textural properties were obtained. The structural properties of prepared carbons were determined with Fourier transform infrared spectroscopy (FTIR) and X-ray powder diffraction (XRPD). These properties were correlated with the electrochemical behaviour of the materials in aqueous acidic and alkaline electrolytes, investigated by cyclic voltammetry. The results revealed that the choice of the activator had a significant impact on the properties of the hydrochars.

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P.S.12.

Novel synthetic approach of $NaCrO_2$ as a cathode material for aqueous sodium ion battery

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The plethora of issues and challenges accompanying the success and the very much needed mass production of the lithium ion battery (LIB) has become widely known today. While the promise of a stable high energy and environmentally friendly energy storage system based on readily available materials serve as a carrot, the scarce and finite amounts of the lithium ores and the environmental impact of its processing, toxicity and safety hazards of LIB constituents serve as a stick in humanity's quest for securing a clean energy future. With a lower redox potential and more abundant, right below lithium in the periodic table of elements, sodium appears as the tastiest carrot of them all. Therefore, in this study, carbon coated layered O3-$NaCrO_2$ was synthesized with a carbon rich chelating agent yielded a promising water stable electrode giving way to a new era of completely green sodium ion battery. A simple gel combustion method with various ratios of ascorbic acid as the carbon source and chelating agent was used in the synthetic procedure. To further improve the cyclic stability, a doping strategy with an earth alkali metal was applied and investigated. As prepared powders were characterized with Fourier transform infrared spectroscopy (FTIR) and their structure identified by X-ray powder diffraction (XRPD). Electrochemical performances were measured by cyclic voltammetry which was performed in a series of conventional and non-conventional aqueous electrolytes. As a result, so far unreported cyclic stability in aqueous medium was achieved and the supporting role of the dopant metal was discussed.

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P.S.13.

Consolidation of strontium hexaferrite sintering by pressureless spark plasma sintering (PSPS)

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Permanent magnets (PM) are key components in currently used enabling technologies and modern devices [1]. Sr and Ba Ferrites are, by volume, world's most-produced permanent magnetic materials [2]. Ferrite magnets are inferior in performance to rare-earth magnets, jet the harmful environmental impact of production, uneven distribution, and increasingly questionable supply, forces us to look for a possible substitution. One such substitute is coming from the group of hexagonal ferrites [3]. M-type ferrite magnets mostly do not contain critical raw materials [4]. In this study we tested Pressurless Spark Plasma Sintering (PSPS) on strontium hexaferrite using graphite, tungsten carbide and silicon nitride die in Spark Plasma Sintering (SPS) device, that enabled to isolate radiation as a sintering mechanism. We focused on comparison of effects of different material used for the heating die on ferrite consolidation. Primary goal of the research was to obtainfully dense, bulk piece with satisfactory magnetic properties using PSPS. Density of the pellets produced was measured geometrically, the magnetic properties were determined using vibrating sample magnetometer (VSM). Based on the obtained data during sintering on the SPS apparatus we prepared a numerical simulation of sintering taking into account different materials of the die, where the heat was produced by Joule heating and transferred to the sample via thermal radiation. Doing this we were able to better understand the course of events in the heating die. Sintered sample microstructure was also analysed with scanning electron microscopy (SEM). The aim of this study is to refine this sintering mechanism to the degree that it would allow us to sinter 3D printed models with complex geometries, thus enabling a fast and relatively affordable way of producing small series or prototype production.

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P.S.14.

Structure and magnetodielectric properties of hybrid ferrite-based nanoparticles

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Ferrites are ceramic materials with unique properties such as ferromagnetism, high saturation magnetization (up to 91 emu/g), high electrical resistance, low electrical losses, and excellent chemical stability. These properties depend on the synthesis conditions, for example, the type of solvent and reaction temperature, which affect the shape and size of the particles. In this study, core-shell ferrite nanoparticles were synthesized by the high-temperature degradation method using metal acetylacetonates as precursors. This study describes the effects of changing synthesis conditions and chemical composition on ferrite-based hybrid nanoparticles' structure, morphology, and magnetic and dielectric properties. The X-ray diffraction analysis confirmed the single-phase spinel structure characteristic for the Fe_3O_4 phase without any impurities. The scanning transmission electron microscope images revealed the core-shell structure of the composites, with Fe_3O_4 as the core and different ferrites as the complex, nanostructured shell. Finally, the magnetodielectric properties of the composites were measured using broad band dielectric spectroscopy over a wide range of frequencies and temperatures. The Fe_3O_4@$CoFe_2O_4$ core-shell structure had the lowest values of the imaginary part of the dielectric permittivity (ε ") equal to 1.13 and the magnetic permeability (μ “) to 0.12 at 293K and 500 MHz.In contrast, the Fe_3O_4@$NiZnFe_2O_4$ composite exhibited the highest values of μ “ equal to 2.27 and ε " to 3.36. Furthermore, the synthesis temperature and solvent type significantly impacted the magnetic and dielectric properties of the core-shell particles. For example, Fe_3O_4@$NiZnFe_2O_4$@$CoFe_2O_4$ composites synthesized in a low-boiling medium (triethylene glycol) had almost 100 times lower values of ε " than their counterparts synthesized in a high-boiling medium (benzyl ether).

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P.S.15.

Evolution of crystal structure and magnetic properties with heat treatment rapidly quenched $Fe_{77.3}Co_5Nb_3Cu_{0.7}B_{14}$ ribbon

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Amorphous and nanocrystalline magnetically soft Fe-based metallic ribbons are one of the key materials that can be used on a large scale in the coming years in devices requiring lighter, more energy-efficient materials. Optimizing the heat treatment process and resulting changes in the crystal structure in as-spun ribbons is crucial to obtain appropriate functional properties, such as magnetic, anti-corrosion or strength.This work aimed to determine the evolution of the crystal structure and magnetic properties along with the controlled heat treatment process of magnetically soft amorphous $Fe_{77.3}Co_5Nb_3Cu_{0.7}B_{14}$ ribbon obtained by the melt-spinning technique. The process of its non-isothermal crystallization was recorded up to 800 °C by differential scanning calorimetry. Additionally, the Curie temperature was determined. Based on the characteristic crystallization temperatures of the α-Fe phase, an isothermal 20-minute vacuum annealing process of toroidal cores in a temperature range from 300 to 660°C was developed. The crystal structure of the annealed materials was monitored using the X-ray diffraction method and transmission electron microscopy observations. The evolution of the magnetic properties (saturation induction, coercivity, remanence, core power losses) was recorded from the B(H) relationship of the hysteresis loop at 50 Hz. The correlations of these results allowed to distinguish two optimal heat treatment temperatures where minima of core power losses occurred. The complex magnetic permeability as a frequency function was determined for samples annealed at these minima. In addition, magnetostriction for that materials was determined. The first minimum was observed at 350 °C and was related to the relaxation of the material and the appearance of the first crystallites of the α-Fe phase. It was characterized by a coercivity of 10.1 A/m, a saturation induction of 1.44T and core power losses in 1T of 0.16 W/Kg. At the second minimum, the material had a fully α-Fe nanocrystalline structure and was characterized by 163 A/m, 1.67T and 0.65 W/kg.

P.S.16.

Effect of storage on electrical properties of MXene films deposited from N-methyl-2-pyrrolidone

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MXenes have attracted a lot of attention due to their unique properties, in particular their high electrical conductivity. The electrical conductivity of MXenes can be influenced by a number of factors, including the method of synthesis and the presence of functional groups on the surface of the MXenes. The influence of aging of a dispersed solution of Ti_3C_2MXenes in N-methyl-2-pyrrolidone (NMP) on their electrical conductivity properties was studied by electro impedance spectroscopy in the frequency range of 4Hz-8MHz in order to analyse the structural changes of MXenes and the stability of the prepared suspension. The NMP-MXenes films were prepared by spin-coating deposition on gold interdigitated electrodes (IDE) followed by evaporation at 100°C. A significant increase in the electrical conductivity and a characteristic change in the shape of the Nyquist plots were observed for the films obtained from the suspension after 50 days of storage. This correlates with changes in the morphology of thin films (size of flakes and difference in coating of IDE) obtained by SEM and AFM, as well as with changes in the chemical composition of MXenes observed in shifts of peaks and different peaks in the spectra of Raman scattering. For the films deposited after 50 days of suspension storage, we also observed sloping lines in the low-frequency range on the Nyquist plots (Warburg resistance).

The relationship between the electrical conductivity of the films and the spincoating deposition speed from 100 to 900 rpm shows the opposite effect, *i.e.* with an increase in the spin speed the electrical conductivity of the films generally decreases whereas charge transfer resistance (R_{ct}) and the capacitive resistance of the double layer increase by three orders of magnitude. This indicates that the MXenes films formed at lower spincoating speeds form a denser IDE coating structure and are capable of faster charge transfer than films formed at higher spin speeds.

P.S.17.

Solar-driven removal of 17α-ethynilestradiol from aqueous environment using green ZnO nanoparticles

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One of the most concerning consequence of the modern society is the unconscious environmental pollution. Even though that all natural fields are equally exposed to the dangerous effects of mankind, the water pollution is the most alarming one. Various persistent organic pollutants, such as pharmaceutically active ingredients, can be found in the aquatic environment. 17α-ethynilestradiol (EE2) is a synthetic hormone and it reaches the water through wastewater or due to the inadequate storage of drugs. EE2 has harmful effects directly on the aquatic organisms (*e.g.* feminization of fish, reduced capability for fertilization, *etc*.) and indirectly on the human health. Hence, sustainable and powerful water remediation techniques should be developed. Heterogeneous photocatalysis is believed to be an adequate process for the removal of persistent organic pollutants. On the other hand, the most commonly applied photocatalysts (*e.g.* ZnO) has their own drawbacks and have to be improved. The aim of this study was to investigate the efficiency of green ZnO nanoparticles (ZnO NPs) based on banana peel extract in the photocatalytic degradation of EE2, under solar irradiation. Various characterization techniques (*e.g.* FTIR) proved the successful formation of green ZnO NPs. Additionally, our findings showed that the new ZnO NPs had decent photocatalytic activity. Namely, ~90 % of EE2 was degraded after 60 min of irradiation. Also, various factors (catalyst loading, initial pH) were investigated on the removal efficiency of EE2. Finally, the possible photocatalytic activity of pure banana peel extract was also examined. The obtained data showed that the plant extract had effect on the photodegradation kinetics and efficiency, although it has to be furtherly investigated in the future.

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P.S.18.

Distance dependence of interaction of TDBC and TCC J-aggregates in layered polymer films

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J-aggregates are highly ordered nanostructures of non-covalently coupled dyes such as cyanines, merocyanines, porphyrins, perylenes, and others. Due to the translational symmetry of the molecules inside such aggregates, the electronic excitations of individual molecules are delocalized over the segments of chains of aggregates with the formation of Frenkel exciton. The distinctive feature of J-aggregates is the J-band, which results from electric dipole transitions into the low-energy edge of the exciton band. This molecular aggregates exhibit many unique spectroscopic properties: very narrow absorption and fluorescence line widths, near-resonant fluorescence, large extinction coefficients, giant third-order optical nonlinearities, exciton superradiance. Thus, they are ideal candidates for novel photonic materials, especially for thin-film applications. J-aggregates, which formed in thin polymer film, may support surface exciton-polariton modes and, therefore, concentrate the electromagnetic field at optical frequencies like metallic nanoparticles. As a result, J-aggregates may enhance fluorescence for monomeric dyes located in their vicinity [1]. In this report, the interaction of TDBC and TCC J-aggregates in layered polymer films was studied using stationary and time-resolved optical spectroscopy. It turned out, that efficient energy transfer can be reached with TDBC J-aggregates as energy donors and TCC J-aggregates as energy acceptors at a minimal distance between them. The interactions of surface exciton-polaritons in these J-aggregates are supposed to bring to increasing fluorescence intensities and lifetimes for both aggregates. The distance dependence of the J-aggregate interaction was considered and is discussed in the frame of surface exciton-polaritons influence.

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P.S.19.

Structure and electrochemical hydrogenation properties of Ni/NiCo/Co powders obtained by femtosecond laser pulses

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The issue of electrochemical hydrogenation of Ni-based nanomaterials continues to be a subject of debate, although it has been investigated for a long time. At the same time, it is known that nanopowders based on Co exhibit a high discharge capacity. With this in mind, our recent research has been devoted to studying the relationship between the structure of mono- and bimetallic Ni/Co nanoparticles and their hydrogenation properties. We present the results of the analysis of the structure and electrochemical properties of Ni/NiCo/Co powders obtained using high-intensity linearly polarized femtosecond laser pulses (wavelength 1030 nm, pulse duration 266 fs).SEM-EDS, XRD, and low-temperature gas adsorption methods were used to investigate the structure of the obtained powders in detail, as well as their electrochemical properties by galvanostatic, potentiodynamic, and chronoamperometric methods. The average size of the obtained particles was large (from 0.1 to 5 μm) and depended on the mode of laser irradiation, the chemical composition of the primary material, and the medium used. The main feature of the synthesized material is that the obtained particles consist of nanocrystals with a size of 20-25 nm, which affects their electrochemical charge-discharge parameters.X-ray diffractograms (DRON-3.0; Co-Ka radiation) showed a significant broadening of the peak, which made it possible to accurately determine the size of the crystal and identify the constituent components. Examination of the Co samples revealed significant oxidation in aqueous media compared to Ni and NiCo. The relationship between the composition of the obtained powders and their electrochemical properties will be analyzed and compared with the results for different types of Ni/Co nanomaterials.

P.S.20.

Superhydrophilic properties caused by femtosecond laser nanostructuring on the Si surface

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This research aims to investigate the effect of laser-induced periodic surface structures (LIPSS) on the wetting properties of silicon surfaces. Specifically, the research focuses on creating high-regularity periodic surface structures on silicon surfaces using femtosecond laser pulses and studying their superhydrophilic properties.The field of laser processing holds a crucial position in the scientific world today. By using lasers, we can manipulate and alter surface structures to achieve desired properties. One particularly promising area of research involves the use of femtosecond lasers in material processing, which allow for precise ablation without causing significant thermal damage. These lasers can generate laser-induced periodic surface structures (LIPSS) that have unique properties and can be created without the need for masks. LIPSS have been demonstrated on various materials, including metals, semiconductors, and polymers, and have found applications in fields such as solar cells, plasmonics, and tribology. Super-hydrophilicity refers to the extreme wetting behavior of a surface that exhibits very strong attraction to water. This property has many practical applications, including self-cleaning surfaces, anti-fogging coatings, and efficient heat transfer surfaces. Femtosecond laser nanostructuring has been found to induce superhydrophilicity in silicon surfaces, which could have a significant impact on a variety of fields, including biomedicine, optics, and energy conversion. The goal of studying superhydrophilic prototypes of silicon surfaces modified by femtosecond laser nanostructuring is to gain a better understanding of this phenomenon and to explore potential applications for this technology.

P.S.21.

The effect of swift heavy ion irradiation on physicochemical properties of monoclinic bismuth vanadate

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Monoclinic bismuth vanadate ($BiVO_4$) is considered to be one of the most promising photoanode materials for photoelectrochemical (PEC) water splitting due to its suitable band gap and band structure, good stability and low-cost synthesis. However, $BiVO_4$ has poor charge transfer properties due to the high rate of electron-hole recombination and understanding the effects contributing to it is important for further improvements. Herein, we report the effect of swift heavy ion irradiation (Xe, 150 MeV, 10^{10} – 5×10^{11} ions/cm^2) on physicochemical properties of hydrothermally synthesized $BiVO_4$ thin films. X-ray diffraction study (XRD) showed that irradiated material preserved initial monoclinic scheelite crystal phase and preferential growth along [010] direction. As the fluence increased, a shift of the diffraction maxima towards lower 2θ values was observed indicating increased interplanar distances. Also, for the 5×10^{11} ions/cm^2 irradiated sample, high degree of amorphization was noticed. Scanning electron microscopy (SEM) of all samples showed prismatic grains with an average size of 600 nm. In irradiated samples formation of ion tracks, ~10 nm in diameter, was observed. X-ray photoelectron spectroscopy (XPS) analysis of Bi 4f, V 2p and O 1s states showed that, after irradiation, increased amounts of V^{4+} and oxygen in the form of hydroxide occurred, especially at higher fluences. By using UV-Vis Diffuse Reflectance spectroscopy we showed that band gap decreased with the increase of fluence. Photocurrent densities obtained from linear sweep voltammetry indicated that irradiation with fluences higher than 10^{10} ions/cm^2 have a notable negative effect on PEC oxygen evolution reaction. However, 1-hour-long chronoamperometry measurements of 10^{10} ions/cm^2 irradiated sample revealed an increase of photocurrent densities. In order to get a better insight into preceding phenomena, we performed XRD, SEM and XPS analysis after PEC process.

P.S.22.

Synthesis and characterization of NiFe layered double hydroxides with different Ni^{2+}/Fe^{3+} molar ratios as multi-functional adsorptive materials

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Environmental pollutions are the main ecological problems needed in the world today, among which the excessive discharge of radionuclides and heavy metals in water causes intense public concern. The development of nanotechnology has made it possible to effectively use the unique properties of many chemical compounds as nanosized mineral phases to prepare new adsorbents. These materials including layered double hydroxides (LDHs) with a hydrotalcite structure.The NiFe-LDH materials with different Ni(II)/Fe(III) molar ratio (Ni_2Fe-LDH, Ni_3Fe-LDH, Ni_4Fe-LDH samples) were effectively produced here by drawing upon the facile *in-situ* hydrothermal method. The NiFe-LDH with the best activity was then modified by inducing oxygen vacancies through a chemical method using citric groups. The effects of diverse solution conditions (e.g., coexisting anionic type, temperature, reaction period, and initial pH) were studied by performing several adsorption tests. Powder XRD patterns of NiFe-LDH with different Ni(II)/Fe(III) molar ratios showed characteristic diffraction peaks, displaying the (003), (006), (012), (110), and (113) peaks of well-crystallized hydrotalcite-like layered double hydroxide materials (phase composition corresponds to JCPDS No. 40–0215). Diffraction peaks at small angles (003), (006), and (009) indicate that NiFe-LDH has a 2D-layered structure. Diffraction lines corresponding to other crystalline phases are not observed in the diffractograms. The interlayer distances according to the first basal reflection (d_{003}) for Ni_2Fe-LDH, Ni_3Fe-LDH, and Ni_4Fe-LDH samples were determined as 7.05Å, 7.13Å, and 7.21Å, respectively. The color of materials changed from brown to green-brown, which indicates the effect of Ni(II)/Fe(III) ratios on the structure of NiFe-LDH.NiFe-LDH removal of Pb(II) and Sr(II) increased with increasing pH from 3.1 to 6.5. The adsorption performance of Ni_2Fe-LDH, Ni_3Fe-LDH, and Ni_4Fe-LDH at equilibrium for Sr(II) removal were 84.4, 90.2 and 99.8 %, respectively. Revealing the relationship between the structural properties of NiFe-LDH and their Pb(II) and Sr(II) adsorption performance deepen our understanding of the fate and transformation of iron (hydr)oxides and inorganic ions in natural environments.

P.S.23.

Removal of toxic dye by eco-friendly biochar derived from sour cherry stone

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In this study, the use of low-cost, widely available waste biomass of sour cherry stone (CS) was used for the production of biochar (CSB), and used as an alternative to the expensive removal techniques for removing toxic dye Brilliant green (BG) from wastewater. Produced CSB was characterized using Fourier Transform Infrared spectroscopy with attenuated total reflectance (FTIR-ATR) and Thermogravimetric method (TG-DTG). FTIR-ATR results indicated the evolution of aromatic functional groups replacing aliphatic groups of CS. The effects of various operational parameters (pH, contact time, initial dye concentration, adsorbent dosage and temperature) were investigated and optimal conditions were determined. According to the results, optimized parameters were: pH 6, contact time of 120 min, initial dye concentration of 50 mg/L, adsorbent dosage of 2 g/L, and temperature of 35 ℃. These parameters were used for kinetic and isothermal investigations. The adsorption of BG was evaluated using two kinetic reaction models (pseudo-first-order and pseudo-second-order). The results showed that the pseudo-second-order model fitted better the experimental data, indicating chemisorption involving valence forces through the exchange of electrons between the dye and CSB. According to the adsorption isotherm analysis, the Langmuir isotherm model better fits experimental data than the Freundlich and Sips models. The maximum monolayer adsorption capacity of BG on CSB was found to be 109.25 mg/g. The R_L value (0.392) verifies that the BG adsorption on CBS is a feasible process. Using CS as a raw material for biochar production, the problem of waste disposal, its decomposition and secondary pollution might be solved. In the same time, this waste materials would gain not only ecological but also significant economic value. These findings demonstrated that CSB, which is made from waste biomass, can be used as a promising and affordable adsorbent for removing dyes from aqueous solution.

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P.S.24.

Recycling of flat glass for glass foam production

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Open loop glass recycling is a process where the glass is recycled into a new product. Glass recycling helps reduce landfill waste. Glass takes up significant space in landfills and does not decompose. In many countries, landfills are filling up faster than we can create new ones. Recycling glass reduces the volume of waste, and increases the lifespan of landfills. One of examples of open loop recycling of glass is glass foam production. Glass foam production is a process that involves the creation of a light-weight glass material with a foam-like consistency. This type of glass is made by mixing a foaming agent with glass powder and heating to temperatures where decomposition of a foaming agent and sintering of glass happens. This results in the creation of a material that is light, strong, and has thermally-insulating properties.

Milled flat glass was mixed with sugar beet factory lime, a $CaCO_3$ – rich waste which has role of a foaming agent, in order to enter 5 % $CaCO_3$ in mixture and pressed at 20 MPa in hydraulic press. Raw pellets were sintered at 800 °C for 30 min. In obtained glass foam phase composition, pore size distribution, compressive strength and thermal conducitivity were determined. Glass foam is emerging as a flexible, cost-effective, and sustainable material that can be utilized in numerous applications to promote sustainable development. Its features such as high insulation capacity, lightweight, and durability make it an ideal material for a wide range of industries.

P.S.25.

The effect of NaCl and SLES on recycled mixture HIPS and ABS contact angles

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This research investigates the effect of a solution of tap water, NaCl and Sodium Laureth Sulfate (SLES) on the surface wetting of the two most common used plastics in refrigeration equipment: HIPS (High Impact Polystyrene) and ABS (Acrylonitrile-Butadiene-Styrene). These plastics, in the form of approximately 2 cm flakes, were identified using the FTIR spectrometer. Then, they were subjected to contact angle testing using the sessile drop method. The aim of this study is to determine the potential of using a mixture of tap water, NaCl and SLES as a solution applicable for flotation separation of plastics with similar densities and surface properties, which are HIPS and ABS.

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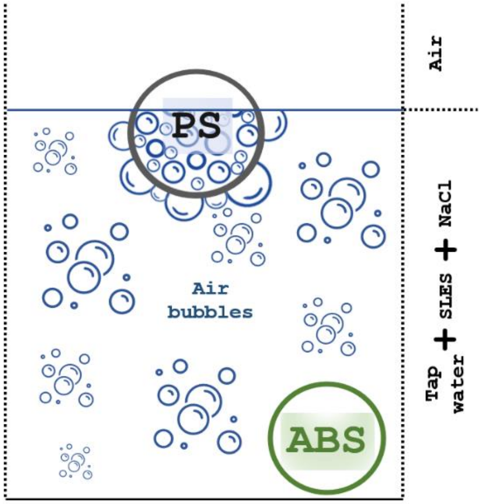

P.S.26.

Novel MXene-anti CEACAM1 complex for melanoma targeted treatment

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Melanoma is considered one of the most malignant and difficult to treat tumors with early metastasis. CEACAM1 (carcinoembryonic antigen-related cell adhesion molecule-1) is one of the cell adhesion molecules that is directly involved in the process of tumor progression. CEACAM1 molecule is a multifunctional receptor protein that is expressed in leukocytes, epithelium and endothelium. This antigen is a mediator of direct interaction between tumor and immune cells, therefore it plays the role of a communicative molecule. It is also important to note that normal melanocytes are CEACAM1-negative, while melanoma cells, on the contrary, have a high level of CEACAM1 expression that should be used for targeted therapy.The search for new opportunities for developing a model of targeted cancer therapy remains a topical issue to this day. Special attention is focused on photo-thermal therapy, which could provide safe and complete tumor eradication with minimal complications. One of the most potentially effective platforms that can exhibit both photo-thermal conversion and targeted delivery are MXenes, novel 2D class of nanomaterials. MXenes have a high ability to bind with positively charged proteins, including CEACAM1. In our research, we provided Ti_3C_2 MXene functionalization and binding with CEACAM1 antigen followed by detailed characterization and assessment of biological properties. We demonstrated that the MXene-anti-CEACAM1 complex opens up a wide range of possibilities and is a potentially effective tool for creating a new model of targeted melanoma treatment.

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P.S.27.

Antibacterial copper nanoparticles loaded pH-responsive nanocapsules for the treatment of infectious wounds

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Infected burns and chronic wounds are extremely painful issues that can progress to severe complications, even to sepsis. In many cases, traditionally used antibiotics are ineffective due to the secondary resistance of many bacteria strains. Recently, the development of inorganic nanoparticles loaded smart nanocomplexes against bacteria strains with antibiotic resistance have got more attention. In the past years, many drug and nanoparticle delivery systems with pH-controlled release in acidic pH region have been developed for cancer treatment. However, there have been only a few attempts to design a pH-triggered delivery system with release in alkaline pH environment of the infectious wound.In this project, we synthesize smart copper nanoparticles (CuNPs) loaded poly(lactic acid) capsules. These capsules release antibacterial CuNPs in the response to alkaline pH of the infectious environment on the principle of electrostatic repulsion. Nanoparticles were synthesized by chemical reduction and stabilized with chitosan of both, low (LMw) and medium molecular weight (MMw). Stabilized nanoparticles were encapsulated in pH-responsive capsules made of poly(lactic acid), a biodegradable polyacid widely used in medicine. The synthesized nanoparticles and capsules were characterized by transmission electron microscopy, dynamic light scattering, and UV-VIS spectroscopy. Finally, encapsulated CuNPs can be loaded into various scaffolds, wound dressings, or hydrogels. Preliminary experiments of CuNPs synthesis compared LMw and MMw chitosan as a stabilizing agent. MMw chitosan coated CuNPs formed particles with an average radius of 203.9 nm, whereas LMw chitosan formed particles with an average radius of 170.4 nm. LMw chitosan particles formed fewer clusters, which can be advantageous for the subsequent encapsulation procedure.

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P.S.28.

The influence of calcification on the microelement composition in the dura mater

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Biomineralization in brain tissues is a frequent and ambiguous phenomenon. Thus, even in normal tissue of the dura mater, according to computed tomography, the frequency of biomineral deposits ranges from 1 to 20% and increases with the age of patients. According to autopsy data, calcifications, including microscopic ones, occur much more often – in 72% of patients. There is also data that Ca, P, and Mg content increases with age. This work focuses on calcification's influence on the dura mater's elemental composition. The study was approved by the Ethics Committee of the Academic and Research Medical Institute of Sumy State University (proceedings 2/12, 08.12.2022). The study was conducted on postoperative tissues obtained during surgical interventions at the neurosurgical departments of the Sumy Regional Clinical Hospital and the Sumy Central City Clinical Hospital and on tissues obtained during autopsies in the Department of Pathology of the Sumy Regional Clinical Hospital (Sumy, Ukraine). Thirty specimens of the dura mater (15 with signs of calcification and 15 without) evenly distributed by gender and age were involved in our research protocol. We performed scanning electron microscopy on an SEO-SEM Inspect S50-B. We have studied dura mater ash samples for Zn, Fe, Mg, and Cu content. Based on the study results, we can conclude that the content of Zn, Fe, and Cu does not depend on the phenomena of biomineralization of the dura mater, unlike the content of Mg, which is 10 times higher in calcified samples. Therefore, we assume that the increased level of Mg in the dura mater is related to biomineralization processes.

P.S.29.

Induction of the DNA comets by $T_3C_2T_x$ MXene is not an artefact of the DNA comet assay

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MXenes are a family of 2D transition metal carbides, nitrides and carbonitrides. Due to their excellent mechanical, electrical and thermal properties, they have been extensively investigated in various fields, including biomedicine. However, wide usage of MXenes in live systems requires thorough investigation of their potential genotoxic and mutagenic effects. We and others reported that $T_3C_2T_x$ MXene at certain concentrations can reduce cell viability in various cell types in cell cultures *in-vitro*. Further studies are needed to understand the genotoxicity of MXenes and develop strategies to mitigate their negative health impacts.The DNA comet assay, also known as single cell gel electrophoresis, is a widely used and sensitive technique for detecting cellular DNA damage. It involves embedding single cells in agarose gel on a microscope slide, lysing the cells, and separating the DNA fragments by electrophoresis. The DNA fragments are then visualized with a fluorescent dye under a microscope. We found that that $T_3C_2T_x$ MXene induce robust appearance of the DNA comets in cultured B16F10 mouse melanoma cells (reported in another YUCOMAT 2023 presentation by I.˚Chorna et al.). The possible genotoxic effect revealed by the DNA comet assay did not correlate with the apparent lack of toxicity of the MXene. We hypothesized that the observed effect could be an artefact of the assay technique.We incubated the untreated melanoma cells at 60 ^{o}C for 30 min to render them metabolically inactive and then treated the cells with the MXene and proceeded with the alkaline DNA comet assay. We found that addition of MXene to the killed cells did not induce the appearance of the DNA comets. This way we confirmed that the observed induction of the DNA comets in cells treated with MXene required metabolic activity of the cells, and was possibly connected with the intrinsic genotoxicity of MXene. Our current research is focused on investigating the mechanism of the possible genotoxicity of MXene.

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P.S.30.

Genotoxicity of $T_3C_2T_x$ MXene revealed by the DNA comet assay depends on the size of the MXene flakes

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MXene is a two-dimensional material made up of transition metal carbides, nitrides and carbonitrides.MXenes show considerable promises for a wide range of applications, including biomedicine. We and other showed that MXenes are generally well tolerated by the living cells. However, concerns have been raised about the potential toxicity of MXenes due to their ability to reduce proliferation of cells in cultures. The DNA comet assay is a commonly used technique for detecting DNA damage in cells. It involves observing the movement of fragmented DNA from a single cell under an electric field, creating the appearance of a "comet". The extent of DNA damage can then be quantified by measuring the length of the comet tail, where longer tails indicate greater levels of the damage.We observed that $T_3C_2T_x$ MXene is able to induce robust DNA fragmentation in living cells revealed by the DNA comet assay (reported in other YUCOMAT 2023 presentations by I. Chorna *et al.* and Zh.˚Klischova *et al.*). The degree of toxicity and genotoxicity of MXenes still remains controversial, as varying results have been shown depending on the specific MXene material and exposure conditions. It is therefore important to further understand the genotoxicity of MXenes and to implement appropriate safety measures to minimize any potential risks.We treated the mouse melanoma B16F10 cells with the fractions of $T_3C_2T_x$ MXene, separated according to the size of the MXene flakes. We found, that the ability of the MXene to induce robust appearance of the DNA comets in cultured cells strongly depends on the size of the MXene flakes, where the size of the flakes inversely correlates with the degree of the DNA fragmentation. The mechanism behind this effect is not yet fully understood. Currently, we investigate the molecular mechanisms behind the observed fragmentation of the cellular DNA and appearance of the DNA comets. We suggest that possible genotoxicity of MXenes requires thorough studies.

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P.S.31.

Genotoxicity of $T_3C_2T_x$ MXene depends on the size of the MXene flakes

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Ivan Baginskiy[2], Veronika Zahorodna[2], Iryna Roslyk[2], Oleksiy Gogotsi[2],
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MXenes are a novel class of 2D materials that have garnered significant attention in the scientific community due to their unique properties and potential applications in various fields, such as energy storage, catalysis and biomedicine. Despite their potential, MXenes are a relatively new class of materials, and their properties and applications are still being explored.

The DNA comet assay, also known as the single-cell gel electrophoresis, is a sensitive and widely used method for evaluating DNA damage. The DNA comet assay can be used to detect a wide range of DNA damage, including single- and double-strand breaks, cross-linking and oxidative damage. We used the DNA comet assay to investigate possible genotoxic properties of $T_3C_2T_x$MXene with various sizes and treatment conditions. For this purpose, we used fractionated MXene with flake sizes from 150 nm to 3000 nm of freshly prepared, 6-month-old and oxidized groups. The assay was done in B16F10 mouse melanoma cells. We visualized DNA fragments using fluorescent microscopy with DAPI dye. We calculated “Tail moment” and “Tail olive moment” parameters using TriTekComet Scorev.2.0.0.38 software and compared them among the groups, as well as with the untreated and H_2O_2 treated controls. We found a strong dependence between the size of the MXene flakes and the extent of the DNA damage. This dependence was nonlinear with a peak of genotoxicity at near 600 nm flake size. In addition, there was a difference in genotoxicity between MXene pretreatment variant groups. Freshly prepared MXene displayed more intensive genotoxicity in comparison to the old and oxidized groups. Importantly, the larger MXene flakes 2000 and 3000 nm in size displayed no genotoxicity. We currently investigate the mechanism of the observed phenomenon of genotoxicity of the MXene.

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P.S.32.

MXene-Based Cardiac Patches for Regenerative Medicine

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The human heart has a low regenerative capacity, which leads to the spread of chronic heart failure in the population after myocardial infarction. The development of cardiac tissue engineering takes a promising scientific position in creating cardiac patches with regenerative and conductive capacity. The use of existing conductive fillers of cardiac patches such as graphene, metallic nanoparticles, and carbon nanotubes is limited by potential toxicity and low biocompatibility. Novel class of 2D nanomaterials, MXenes, could be a reliable alternative to existing conductive nanoparticles. The MXenes promote cell proliferation, differentiation, adhesion, and migration without apparent cytotoxicity. Their high specific surface area and conductivity make them an excellent alternative for transmitting bioelectrical signals between cells. In our research, we developed a biocompatible, electrically conductive, highly porous polycaprolactone (PCL)-based cardiac patch followed by immobilization of $Ti_3C_2T_x$MXenes with different amounts of deposits. Sodium hydroxide (NaOH), sulfuric acid (H_2SO_4), and oxygen plasma treatments were used to improve the hydrophilic properties of the electrospun PCL membrane, followed by studies of biocompatibility and antibacterial properties.Our study showed that the membrane treatment and the number of deposited MXene layers are essential parameters for designing cardiac patches. Two layers of MXene deposited on the PCL electrospun nanofibers represent an optimum that favours cellular attachment and proliferation with a mild antibacterial effect. Based on the data obtained, the PCL-MXene electrospun composites can be used to develop a cardiac tissue substitute.

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P.S.33.

Diffusion-controlled formation of fluorapatite-hydrogel composite for dental implant materials

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Biomineralization is the process of mineralization that occurs within the living organism, and it differs from crystallization in vitro, crystals are formed slowly over a long period of time in a mild environment in vivo. Therefore, biominerals produced by the biomineralization process have a unique structure and have excellent mechanical properties [1]. Among various biominerals, hydroxyapatite including fluorapatite (FAp), which constitute human bones and teeth, have been studied intensively with an aim of biomedical application [2,3]. Mimicking FAp, which has excellent acid resistance and is thermodynamically stable, is important for preventing or treating dental caries as well as developing materials for implants. The main method in previous studies to mimic teeth was to introduce soluble polymers and insoluble matrices into the crystallization process. However, slow and controlled ion transport in living organisms has not been emulated thoroughly. In contrast to rapid mass transfer in a solution medium, the use of a hydrogel medium results in slow diffusion of ions into the hydrogel [4,5]. Therefore, by analyzing the morphologies of crystals formed in the hydrogel matrix, it is possible to understand crystallization process based on the ion supply rate. In this study, calcium ions were diffused in an agarose hydrogel containing phosphate and fluoride ions. By varying the amount of fluoride ions contained in the hydrogel, the influence of the crystallization rate on FAp crystal formation was investigated. The flux of calcium ions decreased with increasing diffusion distance, and depending on the diffusion direction, various forms of FAp were formed. The formation of various morphologies can be explained by the nucleation rate based on the supersaturation of calcium within the hydrogel and also explained the interaction between hydrogel polymers and mesocrystals. This study suggested the understanding on the crystallization mechanism in the initial stage of FAp formation and the possibility of a hydrogel medium applicable to biomedical and therapeutic materials.

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P.S.34.

Synthesis of ZnO-Au nanohybrids electrochemical imunosensors for L. Monocytogenesdetection

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Electrochemical biosensors have shown great potential in the medical diagnosis field. The performance of electrochemical biosensors depends on the sensing materials used. ZnO nanostructures play important roles as the active sites where biological events occur, subsequently defining the sensitivity and stability of the device. Furthermore, ZnO, due to UV activity, high surface-to-volume ratio, efficient charge transport, chemical stability, and what are very important high biocompatibility and low toxicity, can have great potential for modern biosensors. At the same time, gold nanoparticles (NPs) are applied in various applications such as sensors, photovoltaic devices, photocatalysis, and biological labeling due to their extraordinary optical, chemical, and biological properties. Among different morphologies, the one-dimensional nanostructures provide a direct and stable pathway for rapid electron transport. The attachment of Au NPs to semiconductor ZnO nanorods or nanowires is a powerful approach for producing new materials with chemical functionality and photoelectrochemical activity.

Our research mainly aimed to synthesize ZnO-Au nanohybrids for potential use as electrochemical imunosensors for L. Monocytogenes detection. ZnO-Au nanohybrids were synthesized in this work for the specific detection of the L. Monocytogenesantigen. Several types of ZnO-Au nanohybrid were used. ZnO NRs were obtained by the facile sol-gel method[1]. The Au NPs were deposited from $HAuCl_4$ solutions directly onto ZnO nanostructures as nanowires or nanorods in two types of synthesis: simple deposition from aqueous solutions and photo-deposition at room temperature. The structure, crystallinity, and morphology of ZnO and ZnO/Au nanomaterials have been investigated with XRD, SEM, TEM, RAMAN, and FTIR spectroscopy.

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P.S.35.

Physically crosslinked poly(methacrylic acid)/gelatin hydrogels

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Hydrogels are hydrophilic, porous, permeable materials that have been extensively investigated for biomedical applications due to their tissue-like properties. In this work, we investigated physically-crosslinked interpenetrating network hydrogels based on poly(methacrylic acid) (PMA) and gelatin, synthesized by thermally-induced free-radical polymerization. The addition of gelatin increased the formation of hydrophobic domains in the structure of the hydrogels. The increase in PMA and gelatin content led to a lower equilibrium water content (WC), higher thermal stability and better mechanical properties. The values of compressive modulus and strength reached up to 0.75 MPa and 24.81 MPa, respectively, while tensile strength and toughness reached up to 1.44 MPa and 4.91 MJ m^{-3}, respectively, with the WC being higher than 50%. The obtained values for mechanical properties are comparable with the super strong hydrogels previously reported in the literature. In addition, hydrogels exhibited excellent fatigue resistance and biocompatibility, as well as great shape-memory properties, which makes them prominent candidates for a wide range of biomedical applications.

P.S.36.

3D printed bone scaffolds coated with bioactive proteins for regenerative medicine

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Large bone defects present a significant challenge due to their slow healing process. However, the use of 3D printing represents a convincing solution compared to traditional hand-processed and cast materials, mainly due to ability to precisely define the shape, size, and morphology of the final product. This innovative technique enables reliable, precise, and cost-effective production of bone substitutes for regenerative medicine. In this project, a bio-ink consisting of calcium phosphate ceramic powder (CaP) modified with thixotropic biodegradable thermosensitive copolymer and biocompatible polysaccharide was prepared to create a non-toxic and fully bioresorbable material for the human body. The prepared bio-ink paste exhibits thixotropic properties, which enable its transform into a printable biomaterial suitable for direct ink writing (DIW) technology. The scaffolds were created using a biomimetic approach. This method involves 3D printing at low temperatures. Bioactive proteins enhancing regeneration or suppressing infection were incorporated into the printed scaffolds to improve the healing process. The proteins were added post-printing using a coating process with a protein solution. Subsequently, the scaffolds were hardened in an environment with high humidity. Protein release was performed at body temperature in a physiological solution (phosphate buffer saline) and monitored using enzyme-linked immunosorbent assay (ELISA). Finally, the structural and morphological characteristics of the printed samples produced at different extrusion coefficients were evaluated using scanning electron microscopy. This analysis provided insights into the variations in structure and morphology induced by the different printing conditions.

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P.S.37.

Preparation of liposome-enriched system for controlled release of calendula officinalis extract in DFU treatment

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Diabetes affects millions globally, leading to diabetic foot ulcers (DFUs)[1] with impaired healing and bacterial biofilm formation. Due to the misuse of antibiotics[2], there is a need for non-antibiotic alternatives, such as *Calendula Officinalis* extract, supporting faster wound closure and greater size reduction compared to antibiotics[3], improving the DFU treatment. Encapsulation into liposomes preserves the antioxidative and antibacterial activity of the extract, while FUR hydrogel creates a drug-delivery system with controllable degradation, mechanical properties, and antibacterial activity for the intended application. In our previous study, the *Calendula* extract was found to be unstable. To preserve its activity, increase bioavailability, and ensure controlled release, the extract was encapsulated into liposomes using the Mozafari method ($n=5$). The liposomes remained stable over 28 days, maintaining diameters of 85.7 ± 3.9 nm and a consistent zeta potential of -18.9 ± 2.1 mV. Encapsulation efficiency, antioxidant activity, and total phenolic content were measured, showing positive effects, and confirming the suitability of the encapsulated extract for the intended application. The liposomal *Calendula Officinalis* extract will be further incorporated into a suitable hydrogel and the release will be evaluated.

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P.S.38.

The application of a ball-milled Fe-CuSn-Ni powder mixture to fabricate sintered diamond tools

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This article discusses the results of an analysis of mechanical properties of a sintered material obtained from a mixture of elemental iron, tin bronze and nickel powders ball milled for 60 hours. The main purpose of the work was to determine the powder composition on the microstructure and properties of iron-based sinters used as a matrix in metallic-diamond tools. The Fe-CuSn-Ni sinters obtained from a mixture of powders with the mass fractions of individual powders as follows: 60% Fe, 23.8% Cu, 4.2% Sn and 12% Ni. The material after milling was hot-pressing technique in a graphite mould. The microstructure and mechanical properties of sinters was investigated. The investigations of obtained sinters included: density, hardness, static tensile test, X-ray analysis, microstructure and fracture surface observations. The static tensile test was carried out with the use of a universal testing machine with an automatic control and data recording system by Zwick. Based on the recorded data, the following were calculated: yield strength $R_{p0.2}$, tensile strength R_m and relative elongation ε. The observations of the microstructure of the produced sinters were carried out using the JSM-7100F scanning electron microscope, integrated with the X-Max-AZtec series EDS microanalysis system from OXFORD INSTRUMENTS.The Fe-CuSn-Ni sinter revealed a complex phase structure. Point chemical analysis showed the presence of Fe solution, Cu solution and iron oxides. The nickel atoms were distributed throughout the entire sinter volume. The oxides are concentrated in the region of the iron solution. In the area rich in iron, there are also Ni atoms, which easily integrate into the network of Fe atoms because nitrogen has similar sizes of atomic radii. The tin bronze (23.8% Cu, 4.2% Sn) addition to Fe and Ni powders resulted in obtaining a liquid phase during the hot-pressing process which helped to consolidate the phase components. The obtained results indicate that the produced sinters have relatively high hardness and good mechanical properties. The matrix material had a porosity not exceeding 3% as well as mechanical properties that would allow to replace cobalt-based sinters.

P.S.39.

Physico-mechanical properties of powder coatings using residues of industrial wastewater treatment

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A processing method of iron-containing industrial waste for its further utilization in the composition of powder coating materials is proposed. The object of the study is waste, which contain toxic heavy metal. The possibility of using these wastes of electroplating water treatment for obtaining commercial products is to ensure operational characteristics at the level of standard samples. This problem is solved by using of ferritization processing of liquid industrial waste, which makes it possible to consider the obtained compounds as secondary material resources in the production of powder coatings. It has been established that the utilization of waste by the ferritization method of waste water treatment ensures the production of coatings that have physical and mechanical characteristics at the level of the requirements of current standards. Application of AC-magnetic field activation of the reaction mixture for ferritization process is associated with significantly lower energy consumption (by 60 %) compared to the thermal one. Introduction of 15 % by mass. either of wastewater treatment sediments or spent polyvalent ferrum oxide sorbent in the composition of the coatings leads to improvement of the physical and mechanical properties of the coatings. So, using spent sorbent, the rebound strength increases from 20 to 40 cm/kg, the tensile strength − from 5 to 7.4 mm, the bending strength decreases from 8 to 5 mm and the corrosion resistance of the coating increases by 1.5 times compared to the standard sample. The obtained data are explained by the introduction into the coating of chemically and thermally stable crystalline phases, which have ferromagnetic properties. As a result, obtained coatings increase shielding of electromagnetic radiation in the megahertz range by 3 times compared to standard ones. The advantages of energy-saving ferrite methods of wastewater treatment of galvanic industries are the extraction of important ferromagnetic substances from liquid waste for their further use in construction materials of special purpose.

P.S.40.

Synthesis and characterization of Ni(III) complex with condensation product of 2-acetylpyridine and Girard's P reagent

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The ligand (HLCl) was synthetized by the reaction of 2-acetylpyridine and Girard's P reagent in molar ratio 1 : 1 in ethanol (1–2 drops of cc. HCl were added). The reaction of hydrazone ligand with the metal salt $Ni(BF_4)_2 \cdot 6H_2O$ and NaN_3 in a molar ratio 1:1:4 in methanol/acetonitrile/water mixture results in the formation of Ni(III) complex with composition $[NiL(N_3)_3]$ (Figure 1). The tridentate ligand (HLCl) is coordinated in deprotonated, formally neutral, form to the nickel ion through NNO set of donor atoms forming two five-membered chelate rings and the other three coordination sites are occupied by meridionally coordinated azide anions. The ligand (HLCl) was characterized by elemental analysis, IR and NMR spectroscopy and structure of the complex was defined by X-ray analysis, IR and EPR spectroscopy, molar conductivity and elemental analysis. DFT calculations were performed to determine stability and rationalise formation of Ni(III) complex.

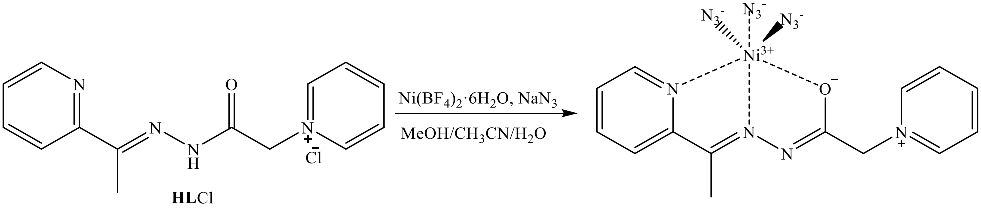

Figure 1. *Synthesis of complex $[Ni(\mathbf{L})(N_3)_3]$.*

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P.S.41.

Optimisation, prototyping and production of metallic catalyst supports from $CuNi_2SiCr$ by Selective Laser Melting technology

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Selective Laser Melting (SLM), also known as Laser Powder Bed Fusion (L-PBF), is an additive technology utilizing laser beam to melt and solidify powdered alloys in a layer-by-layer manner. This approach allows for creation of easily-adjustable, intricate geometries in a single technological step, using only printer, feed powder and a CAD model of the printed item. The bulk of current research concentrates on iron- and titanium-based alloys as the feed material for the SLM process. However, there is much less data concerning the usage of copper alloys, mainly due to technological difficulties associated with the processing of this group of materials, such as high heat conductivity and low laser energy absorption. These alloys, thanks to their high thermal conductivity and good corrosion resistance, can be used in the production of metallic catalysts supports dedicated especially for the high-temperature chemical processes.

In this study, a relation between the printing parameters like laser power, scanning speed or hatch distance and the resulting microstructure was proposed for the $CuNi_2SiCr$ alloy. Material properties like density, Vickers hardness, corrosion resistance and phase composition through the means of XRD were assessed. Due to $CuNi_2SiCr$ being a precipitation-hardenable alloy, there was an attempt at establishing an optimal heat treatment for the printed samples in order to further enhance their mechanical properties. Finally, to test the possibility of catalysts support manufacturing, three different batches of porous cellular structures were printed and their mechanical behaviour was investigated.The acquired data can be applied to manufacture complex geometries with tailored microstructure and material properties, which may be further applied in production of catalytic substrates made from durable, corrosion-resistant and highly conductive copper alloy.

P.S.42.

A study of long-term oxidation resistance and its mechanism in films based on CrN deposited on stainless steel

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Bipolar plates and current collectors are critical metallic components for commercial MCFC stacks. In fact, for commercial MCFC systems, up to 55 % of the material content could be the metallic hardware (for the complete system) which includes cell, stack, and balance-of-plant materials. Stainless steels like 310 S (24–26 wt.% Cr) and 304 L (16–18 wt.% Cr) have emerged as materials of choice for MCFC hardware. However, the hot corrosion in the presence of the carbonate melt is a critical issue with these materials for long-term operation. One of the methods of protecting and improving the corrosion properties of steels is the application of coatings based on nitrides. The corrosion resistance of Cr-N coatings is better than that of stainless steel and other nitride coatings. The coatings were deposited on polished 304L stainless steel specimens using a Cr cathode and the vacuum arc method. During the deposition of the chromium nitride layer, the nitrogen filling pressure was 2 Pa (variant #1 and #3) and 0.2 Pa (variant #2 and #4 Table 1). To avoid diffusion of chromium from the substrate during long-term oxidation, it was suggested to apply a protective copper sublayer (variant #3 and #4 Table 1). Oxidation resistance and electrical conductivity of coatings after long-term (1000 h) holding at 600 °C in air were studied. The electrical conductivity of obtained coating was $3.5 \cdot 10^5$ S/m.

Table 1. PVD modes and thickness of the obtained coatings

	Pressure of N_2, Pa	Bias voltage, V	Cu thickness, μm	CrN thickness, μm
#1	2.0	150	-	16.6
#2	0.2	120	-	6.9
#3	2.0	150	0.3	4.1
#4	0.2	120	0.3	2.2

It was established that coating variant #1 has the highest oxidation resistance, but coating variant #4 has greater electrical conductivity after long-term exposure at 600C in air.

P.S.43.

Gas-detonation surface modification for dental implants

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Titanium and its alloys widely used in dentistry and orthopedics due to high biocompatibility and appropriate mechanical properties. Different surface modifications, including sand-blasting, acid etching, plasma electrolytic oxidation, are used to improve osseointegration and osseoinductive capacity. Despite positive clinical outcomes of existing implants, new technologies required to decrease postoperative complications and increase implantation success rate. Both topography and chemical composition of the implant's surface are essential to osseointegration and we aimed to compare different deposition substrates using gas-detonation method. We used the gas-detonation deposition (GDD) method to modify the titanium substrate surface. We used two groups of powder: hydroxyapatites (HA) and zirconium oxide (ZrO_2) particles with dimensions of 20, 50, and 100 µm to provide formation of gas-deposit layer on Ti discs. Sandblasted titanium samples were used as a control group. Structural, chemical and biological characterizations were applied to assess new implant surface. SEM demonstrated rounded and polygonal deposits of various sizes on the surface of all test samples. The thickness of this layer was from 10 µm for HA deposition and up to 270 µm for ZrO_2. The deposited layer was firmly attached to the sample regardless of the thickness. Static contact angle measurement demonstrated no hydrophilicity with a best result of 107° for the 20 µm ZrO_2 sample. Incubation of human skin fibroblasts demonstrated the lack of cytotoxicity and high cell adhesion to the surface of all tested samples. The use of substances with ZrO_2 significantly increased cell proliferation compared to the control and the use of HA substances. After the flow degradation of the samples in the SBF solution for 6 months, there was a partial smoothing of the surface relief and a decrease in the size of the deposits. To summarize, GDD with ZrO_2 particles could be simple and reliable method for implant surface modification towards increasing of osseointegrative parameters for dental and orthopedics implants.

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P.S.44.

The combined effect of modification and grain refinement in aluminium silicon alloys

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Aluminium – silicon alloys have a wide range of applications in the automotive and aerospace industries due to an excellent combination of castability and mechanical properties, as well as good corrosion resistance and wear resistivity. Grain refinement and modification of castings are ways to control the microstructure. Small additions of e.g. AlSr10 or AlTi5B1 to an Al-Si2 and Al-Si12 alloys can give different phases. Modification of Al-Si alloys becomes important in alloys with more than a small percent Si. Most hypo-eutectic Al-Si alloys are modified in order to convert the primary Si platelets into a fibrous structure. Grain refiner AlTi5B1 and AlSr10 modifiers do not affect each others action. In hypo-eutectic Al-Si the first nucleating phase is primary α phase. Additions of AlSr10 or AlTi5B1 master alloys were made 3 to 4 minutes before casting. In the case of a combined addition of AlSr10 and AlTi5B1, the AlSr10 was added first. Addition of Sr to the Al-Si alloys changes the eutectic particles morphology.

P.S.45.

Simplified doping-free electroluminescent device reaching 4.6 % of external quantum efficiency with the derivative of 1*H*-1,2,3-triazole as emissive layer

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The most state-of-art thermally activated delayed fluorescence (TADF)-based organic light-emitting diodes (OLEDs) are fabricated using complicated multi-layered structures containing many functional layers typically based on guest-host/co-host systems with a specific combination of electronic properties of guests and hosts. However, efficient TADF-based OLEDs with few host-free layers are limited due to the limited emitters with a perfect combination of required electronic properties. Especially in the case of blue OLEDs, device efficiencies decreased a lot when one or more functional organic layers are skipped from OLED structures. Our aim was to obtain favourable combination of electronic properties with emission in the blue spectral region by constructing OLED with a very simple structure ITO/CuI/TCTA/emitting layer(EML)/TPBi//Ca/Al. We utilised newly synthesized carbazole-containing derivatives of 1*H*-1,2,3-triazole as EMLs due to their TADF-originated bluish-green emission and high PLQYs in solid state. The maximum EQE of 4.6 % was achieved for the device that consisted of 4-(9*H*-carbazol-9-yl)phenyl)(1-(m-tolyl)-5-(trifluoromethyl)-1*H*-1,2,3-triazol-4-yl)methanone as emitting layer. The fabricated OLED exhibited greenish-blue emission with electroluminescence spectrum characterized by Commission International de l′Eclairage (CIE) coordinates of (0.34, 0.46). Our research indicates, that by carefully engineering donor-acceptor type molecules based on 1*H*-1,2,3-triazole core, it is possible to fabricate efficient OLEDs even with very simple structure.

P.S.46.

1,8-Naphthalimide derivatives with room temperature phosphorescence detectable in solid and liquid media

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In the past two decades, the inherent flexibility of molecular design has played a crucial role in the development of a wide range of organic compounds for organic light-emitting diodes (OLEDs) [1]. The First generation of OLEDs primarily utilized fluorescent molecules, resulting in an internal quantum efficiency (IQE) of only 25 % since only singlets were harvested. Conversely, the second generation of OLEDs uses phosphorescent materials, allowing for the harvesting of singlet and triplet excitons through intersystem crossing where, in theory, the IQE of 100 % can be reached [2]. The conventional phosphorescent materials rely on expensive, toxic, and limited metal complexes. Thus, the design and development of purely organic room temperature phosphorescence (RTP) materials have become highly desirable [3]. We aimed to study the effect of bromine atoms on the RTP efficiencies of new 1,8-naphthalimide derivatives.

In this work, we investigated the photophysical properties of two derivatives of 1,8-naphthalimide (abbreviated as MNB and MND) in different states: powder, melt-casted, and dispersed in both liquid and solid media. In addition, the thermal and electrochemical properties of both compounds were investigated. Both of the compounds, MNB and MND, exhibited RTP in deoxygenated solutions and in vacuumed polymer matrix. The impressive ratio of fluorescence quantum yield to RTP quantum yield was 17.11 and 17.22, respectively. RTP spectra of MNB and MND peaked at wavelengths of 596 nm and 598 nm, respectively. The RPT lifetimes of these compounds exceeded 1 ms. Moreover, both compounds demonstrated aggregation-induced emission enhancement reaching photoluminescence quantum yields of 29.36 % and 34.42 % in the solid state. Efficient RTP properties of MNB and MND were attributed to the heavy-atom effect of bromine.

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P.S.47.

Transport properties for Ar^+ in CF_4 gas for technological applications

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Cold plasmas are often exploited in new technologies where they favorably offer non-intrusive production or modification of various substances. The ion-molecule collision model for endothermic reactions created by Denpoh and Nanbu theory (DNT) has been extended to exothermic reactions. Understanding the plasma distribution, characteristics and phenomena is important for the development and optimization of plasma equipment for the production of semiconductor devices, such as etching and deposition tools. For this reason, plasma simulation is currently used in every phase of equipment design, development and improvement.

Monte Carlo simulation method is applied to accurately calculate transport properties in hydrodynamic regime. These data are needed for modeling in numerous applications of technologically important. We discuss new data for Ar^+ ions in CF_4 gas where mean and characteristic energy, flux and bulk values of reduced mobility are given as a function of reduced electric field *E/N* (*E*-electric field, *N*-gas density).

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P.S.48.

Electron structure and peculiarities of the valence state of Ce (Yb) in RM_4Al_8(R=Y, Ce, Yb; M=Cr, Mn, Fe, Cu)

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We have studied experimentally and theoretically the electronic structure and x-ray absorption spectrum at the Ce (Yb) L_{III} -edge (77 and 300 K) and x-ray emission spectra of M and Al at the *K*- and $L_{2,3}$ -edges in the compounds RM_4Al_8 (with $ThMn_{12}$ type crystal structure). The theoretical calculations have been carried out by means of the *ab initio* fully relativistic spin-polarized Dirac linear muffin-tin orbital method. Yb-based compounds exhibit several interesting properties that include mixed-valence, heavy fermion behaviour, Kondo effect, magnetic ordering, and superconductivity. We will also discuss the issues related to the complex magnetic configuration of $YbFe_4Al_8$ and present a model of the crystallographic structure of the considered compound. One motivation for studying $YbFe_4Al_8$ is to determine its valence. ^{57}Fe Mossbauer spectra (MS) of $YbFe_4Al_8$ have been investigated. Mossbauer measurements at the lowest temperatures yield information on the iron population in three crystallographic sites 8f, 8j and 8i available for Fe atoms. The obtained results indicate the coexistence of magnetically ordered and paramagnetic-like Fe moments within antiferromagnetic phase of $YbFe_4Al_8$. The MS measurements show that the onset of short-range antiferromagnetic interaction in the Fe sublattice takes place at 220 K. The mixed valence state of Ce was observed in CeM_4Al_8 with M = Cr, Mn, Fe. In the case of M = Cu the Ce^{3+} state is stabilized, but the Yb-based compound shows intermediate valence ($V_{\mathrm{Yb}} \approx 2.5$). In other Yb-based compounds, the Yb ion is mainly in the trivalent state. The temperature dependence of the magnetic susceptibility of RFe_4Al_8 compounds fit the Curie-Weiss law over a wide temperature range. The K- and L-spectra of Al and M -elements aligned in the unified energy scale and the X-ray electron spectrum of valence electrons of the RM_4Al_8 compounds. Occurrence of the so-called p-d-resonance can be a reason for stronger Cu-Al binding in the RM_4Al_8 compounds. Because of this resonance the p-states of Al are partially knocked out from the d-level energy localization range, increasing by this the aluminium p-states density near the Fermi level. Substitution of Ce by Y causes a decrease of crystal lattice, resulting in more symmetrical distribution of the p-density of aluminium. The value of splitting is 3.5 eV and practically does not differ from that we have revealed in the $RCu_4 Al_8$ compounds. The calculations show good agreement with the experimental measurements.

P.S.49.

Dual quantum dots-doped glass nanocomposites for high-performance luminescent solar concentrators

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Global energy consumption continues to rise, prompting a need for renewable energy sources. Solar energy is a promising solution due to its abundant availability and compatibility with various systems. However, the high price/performance ratio of solar cells has hindered its wider adoption. Herein, luminescent solar concentrators (LSCs) offer a potential solution by increasing the energy conversion efficiency of photovoltaic systems. In this study, we propose the use of dual quantum dots (QDs)-doped glass nanocomposites (GNCs) as a host/wave guide material for LSCs. Compared to existing approaches that use organic dyes or wet chemistry methods, QD-doped GNCs offer several advantages, including simple synthesis, machinability, scalability, recyclability, and superior durability and optical properties. Hence, the aim of this work is to develop high-performance GNC-based LSCs with excellent optical transmittance, refractive index, and photo resistivity, as well as long-term stability in harsh outdoor conditions. For this reason, CdSe and perovskite ($CsPbBr_3$) QDs are synthesized via melt-quenching and subsequent controlled heat-treatment processes to obtain wavelength convertors for downconversion of UV photons to visible photons. The resulting QD-doped GNCs are characterized for their thermal, chemical, and mechanical durability properties, as well as their optical and photoluminescence (PL) features. The potential of GNC-based LSCs for practical applications are evaluated using solar simulators to calculate energy conversion efficiency, reflection loss, critical escape angle, and trapping efficiency. The outcomes of this work are expected to contribute strategically to the development of novel LSCs for sustainable environment and energy applications.

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P.S.50.

SPS sintering of B_4C-SiC composites

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Boron carbide (B_4C) - silicon carbide (SiC) ceramic composites were obtained through the densification of B_4C and β-SiC powders with different ratios using the spark plasma sintering (SPS) technique. The thermal treatment was carried out for 5 min in Ar atmosphere in a temperature range from 1850 to 2000 °C under a pressure of 70 MPa. The effect of starting powders ratio on the sintering behavior, relative density, microstructural development, and mechanical properties of the obtained composites was investigated. The obtained results showed that only starting compounds, *i.e.* B_4C and SiC phase, are observed in the sintered ceramic materials. SEM micrographs revealed that the sintered composites are composed of densely compacted B_4C and SiC grains with a uniform distribution of both phases. The maximal relative density value (100 %) was achieved for the sample densified at 2000 °C with 25 % of B_4C and 75 % of SiC. The microhardness of obtained composites ranges from 33 GPa to 43 GPa, depending on the constituents' content and the densification temperature. The maximal microhardness value was achieved for the composite densified at 2000 °C which contains a maximal amount of B_4C (75 %). In order to examine the behavior of composites in extreme conditions, the surface changes induced through the interaction of obtained composite materials and CO_2 pulse laser were also studied. During the irradiation, the laser pulse duration was ~2 μs with average pulse energy of 120 mJ. The results of this study show that the SPS technique can be a very effective densification method for the obtainment of additive-free B_4C - β-SiC ceramic composites with promising properties for application in radiation at extremes.

P.S.51.

New rare-earth free red-emitting $CaAl_4O_7$:Cr^{3+}crystallophosphors

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Calcium and strontium dialuminates (Ca/Sr)Al_4O_7 with a monoclinic grossite type structure have been intensively researched during the last decades as promising rare-earth (RE) free host materials for diverse luminescent applications. Specifically, the luminescence of Bi^{3+} ions in a $CaAl_4O_7$ matrix is suitable for improving the rendering index of white LEDs, whereas the emission of Bi^{2+} at 720–850 nm appearing in the 1st biological window is attractive for bioimaging applications. Mn^{4+} or Cr^{3+} doped materials with broadband excitation in the UV and visible regions of the spectrum and deep red radiation, are also being explored as an alternative to RE-activated phosphors. In this study a series of Cr^{3+}-doped $CaAl_4O_7$ nanocrystalline powders with average grain size of *ca.* 80 nm were obtained by a facile sol-gel combustion route followed by successive heat treatment in air at 900, 1000, 1100, 1200 and 1300 ºC. It was revealed that a peculiarity of the $CaAl_4O_7$ grossite structure is the presence of two non-equivalent tetrahedral positions of Al^{3+} ions and one position of Ca ions in pentagonal bipyramidal coordination, which are suitable for incorporation of Cr^{3+} ions. The photoluminescent properties of $CaAl_4O_7$ nanophosphors activated with Cr^{3+} ions were studied over the temperature range of 4.5–325 K. The samples show deep-red and near-infrared luminescence due to the $^2E \rightarrow {}^4A_2$ and $^4T_2 \rightarrow {}^4A_2$ energy level transitions of Cr^{3+} ions under excitations in the two broad emission bands in the visible spectral region. The R-lines emission showed strong temperature dependence. The feasibility of the $CaAl_4O_7$:Cr^{3+}material for non-contact luminescence sensing is investigated and good sensitivity is obtained based on the (R_2/R_1) luminescence intensity ratio and lifetime of the emission.

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P.S.52.

Material with a low work function based on multilayer graphene intercalated with rubidium

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Field emission is associated with electrons overcoming a potential barrier, the value of which is determined by the work function of the cathode material. In the case of field emission, the external electric field reduces the height and width of the potential barrier. With the development of nanophysics and nanotechnology, ways to solve the technological and energy problems of field emission, associated with the need to use a powerful electric field, appeared. Namely, the manipulation of the structure of matter at the nanoscale level allows creating the materials with a low work function and nanostructures with a large aspect ratio. One of such manipulation relates to well-known mechanism of doping and adsorption. Currently, there are relatively few works devoted to the study of the effect of surface intercalation of graphene-like carbon nanostructures on the work function. This work is devoted to the development the methods of graphene layers creation and their near-surface layers subsequent intercalating with alkali metals' atoms (rubidium), to reduce the work output of the material and to form surface elements with a large aspect ratio. Graphene nanoplates previously obtained by electrochemistry are deposited from a colloidal solution onto the surface of a nickel substrate using electrolysis. Electron microscopic studies demonstrated the effect of graphene flakes coalescence into a continuous layer with good adhesion to the substrate. The contours of individual graphene bundles are well visible on surface and their side faces is convenient for intercalation. Certain parts of graphene sheets are almost perpendicular to the surface and can serve as centres for effective field emission. Such surface elements are formed due to defects in graphene flakes, which play a positive role. The rubidium intercalation is carried out from both separate RbI solution and graphene flakes and RbI salt colloidal solution. The electrochemical synthesis method is promising to manufacture the Rb intercalated graphene layers as working part of cold cathode for field emission.

P.S.53.

Low-temperature elastic, dissipative and structural properties of doped non-equiatomic high entropy alloys of the Fe-Co-Ni-Cr system

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High-entropy alloys (HEAs) were first manufactured in 2004 [1]. Initially, it was believed that such materials should consist of at least 5 elements, the concentration of which is close to equiatomic. At the same time, the structure of such HEAs will consist of simple single-phase solid substitution solutions with fcc or bcc lattices. It was also established that the strength of such equiatomic HEAs, by analogy with traditional alloys, can be further improved by reducing the size of grains in their structure to the nanoscale. However, the increase in strength of equiatomic HEAs with a decrease in grain size was accompanied by a harmful decrease in their plasticity and impact strength. Efforts to overcome this obstacle have led to the appearance in the last few years of non-equilibrium multiphase non-equiatomic HEAs. In contrast to balanced single-phase HEAs, these materials were created on the basis of multicomponent solid substitution solutions with concentration of components different from the equiatomic. Thanks to activate alternative mechanisms of plasticity during preliminary deformation, it is possible to increase the plasticity of these HEAs while maintaining high strength. Such alternative mechanisms of plasticity are "plasticity induced by twinning" - TWIP and/or "plasticity induced by phase transformations" - TRIP. It is hoped that further enhancement of the plasticity of such alloys is possible by adjusting the contribution of competing TWIP and TRIP mechanisms through doping [2, 3]. In this work, for the first time, the elastic and dissipative properties of doped non-equiatomic high entropy alloys of the Fe-Co-Ni-Cr system were measured and analyzed by the method of resonant mechanical spectroscopy. In a wide temperature range of 4.2–425 K, a correlation was established between the features of the temperature dependences of the dynamic Young's modulus and internal friction with changes in the phase and structural state.

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P.S.54.

Concentrated solar radiation synthesis of metal–carbon heterostructures for low-temperature thermionic converter

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The technologies of direct conversion of thermal and radiant energy are important to prevent climate changes. The carbon nanostructures opened a way to solving this problem. The traditional alloying of diamond-like materials allows reducing the operating temperatures and voltages of cathode set-up. Needle-like carbon nanotubes and blade-like graphene layers with high aspect ratios make it possible to increase the contribution of autoelectronic emission for both field emission devices and thermophotoemission energy converters. At the same time, both the structural complexity of necessary materials and the complexity of their production processes are increasing. The method of carbon nanostructures synthesis used concentrated solar radiation is proposed and investigated. The idea of the method is a ‘self-assembly’ of the cathode material for thermionic energy converter (TEC) immediately in the vacuum chamber after its installation in the solar collector. The initial materials are hydrogenated titanium powders and thermally expanded graphite (TEG) or carbon nanotubes (CNT), which are mechanically mixing and pressed into steel form (cathode). After annealing in the sun, the surface of the cathode is significantly modified. First, the rapid destruction of TEG or CNT (high absorption capacity) leads to deposition of carbon nanostructure residues on colder metal particles. In the area of the sample exposed at higher temperatures (up to 700 °C), the formation of a thin layer of amorphous carbon on the metal particles predominates, presumably with numerous icicle-like structures (5–50 nm). In regions with lower temperatures, a branched network of randomly oriented CNT (d=10–50 nm) is formed on the metal particles. All these structures are effective emitters of electrons. It was previously shown for such material that the temperature of emission start is reduced to 200 °C. In addition, the proposed technique can be used as a method of CNTs’ synthesis.

P.S.55.

Using a phosphor of the high effective atomic number to recognize radioisotopes by means of absorbed dose measurement in pair with the tissue-equivalent dosimeter

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If the effective atomic number Z_{eff} of the dosimetric detector differs from the Z_{eff} of the human body, then it will register the absorbed dose value of the gamma-radiation that differs from the dose got by the human body or the tissue equivalent detector at any energy other than that at which it was calibrated. This feature of the non-tissue equivalent detector is usually considered as a disadvantage but it can be used for emergency dosimetry when it is necessary not only to evaluate the absorbed dose, but also to identify the type of source of unknown radiation as soon as possible, *e.g.* if the terrorists use some kind of radiation dispersal device which got a common media term a "dirty bomb". The problem of gamma-radiation distinguishing of radioisotopes which could most probably be used in such a case and the feasibility of solving it is analyzed considering the use of the high Z_{eff} dosimetric phosphor in pair with the low Z_{eff} tissue-equivalent dosimeter of BeO ceramics (Z_{eff} = 7.1). The yttrium aluminum perovskite activated with Mn (YAP:Mn = = $YAlO_3$:Mn) with Z_{eff} = 31.4 is considered for this purpose because it showed its promising dosimetric properties before. As even more heavy LuAP:Mn (Z_{eff} = 61.6) which is not studied yet is considered too as potential dosimetric materials for this purpose. The possibility of identifying the radiation source was analyzed as recognition of discrete values of the measured doses ratios using a decision-making rule. The last was aimed at minimizing the discrimination error and was based on characteristic dosimetric sensitivities ratios for radioisotopes of interest. The analysis shows that using the YAP:Mn/BeO pair the requirements for the dose measurements accuracy are too high that's why the need for dosimetric phosphor of higher Z_{eff} is discussed.

P.S.56.

Bioactive, water-based paints for camouflage painting of plastics – functional characteristic and the assessment of singlet oxygen photogeneration ability

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Camouflage painting made with a paints with appropriate spectral characteristics ensures a proper level of masking of tools and machines used by the armed forces. Steps have been taken to develop formulas of bioactive coating compositions for camouflage cover of protective masks made of polyamide 12 in SLS 3DP technology. On the basis of a water-based, self-crosslinking 1K acrylic copolymer dispersion, a set of masking paints in green, brown and black colors was prepared. The entire formulas were enriched with an antimicrobial additive in the form of colloidal silica with nanosilver and glass flakes containing silver, zinc or copper ions, in the amount of 2 or 4 wt%. The ability of the discussed coating materials to photogeneration of singlet oxygen was tested by observing the photooxidation process of 1,5-dihydroxynaphthalene (DHN). For the developed paints, the re-emission coefficient was determined and a colorimetric analysis was performed. Hardness, roughness, resistance to delamination from the substrate as well as water/diiodomethane wettability and surface energy of cross-linked coatings were also assessed. All of the tested samples, when irradiated, showed the ability to generate reactive oxygen species capable of limiting the growth of microorganisms. The degree of DHN degradation recorded during the study reached 85 %. Moreover, the cross-linked coatings are characterized by a favorable system of functional properties, including excellent adhesion to polyamide, which predestines them for use in the defense industry.

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P.S.57.

Tuning the colour of topcoats – method for selection of pigments and safeguarding colour stability

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The basic task of anticorrosive coatings is protection against corrosion and in many cases aesthetic (gloss and colour) properties, important for the investor. Pigments, responsible for the colours are often unstable and under the influence of sunlight and other factors they break down. As a consequence, pigments stop absorbing and reflecting specific wavelengths of light resulting in a change in colour. Aesthetic appearance over a long period of use can be achieved by the appropriate selection of a top coat characterized by colour stability, gloss and other surface properties. Requirements for colour fastness of powder coatings are included in the Qualicoat, Qualisteel, AAMA and GSB standards, but no recommendations have yet been made for liquid paints.The main goal of work is to determine with high probability how topcoats should be modified in order to improve the resistance to weather conditions, with particular emphasis on optical properties (gloss retention, colour). The results of colorimetric tests, structure and topography of coatings and the generation of stresses under the influence of various variable exposures have been used to specify how long aging tests should last and what cycles are most suitable to obtain a sufficiently large variation of results, and thus the information needed for the optimization of formulations.

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P.S.58.

Na_2EDTA-assisted hydrothermal synthesis of $LiFePO_4$

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In order to reduce the pollutant emissions, especially in urban areas, vehicles with internal combustion engines should be replaced. The best replacements are electric vehicles that run on batteries and hybrid electric vehicles that use a combination of batteries and an internal combustion engine. Lithium iron phosphate ($LiFePO_4$) is one of the most promising cathode active materials for lithium-ion batteries due to its high storage capacity, good thermal stability, low cost, and environmental friendliness. Hydrothermal synthesis is among the most advanced techniques for obtaining $LiFePO_4$. Many parameters, such as temperature and duration of treatment, concentration of reactants, and pH of the starting solution can influence the particle size and crystal structure of the hydrothermally synthesized $LiFePO_4$ powder. The aim of this study was to optimize the hydrothermal synthesis of $LiFePO_4$ in order to obtain a powder with uniform morphology. In addition to $LiCH_3COO \cdot 2H_2O$, $Fe(CH_3COO)_2$, and NaH_2PO_4 as starting materials, Na_2EDTA was used as a surfactant, while urea helped to regulate the pH during synthesis. The molar ratios of Li:Fe:P in the aqueous precursor solution were 1:1:1 and 3:1:1. Nitrogen was introduced into the precursor solution to prevent oxidation of Fe^{2+} to Fe^{3+}. The precursor solution was transferred to a teflon-lined stainless steel autoclave and heated at 160 °C and 190 °C for 10 h. The obtained powders were characterized by FESEM and XRD.

P.S.59.

Electrochemical behaviour of $Na_4Fe_3(PO_4)_2P_2O_7$ cathode in the lithium nitrate aqueous solution

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Since Goodenough et al. introduced mixed-polyanion systems into the world of Li-ion batteries, the mixed phosphate-pyrophosphate compounds ($M_4Fe_3(PO_4)_2P_2O_7$, M = Li, Na, K and Zn) have attracted great attention as new cathode materials for different metal-ion batteries. As evidenced by literature, the preparation of $M_4Fe_3(PO_4)_2P_2O_7$ (M = Li, K and Zn) is very difficult, even impossible, through direct synthesis method. However, these polyanionic structures can be produced from their sodiated form *i.e.* $Na_4Fe_3(PO_4)_2P_2O_7$ (NFPP), upon its smooth and fast electrochemical exchange of Na^+ ions with Li^+, K^+ or Zn^+ ions, which make this compound an interesting cathode for these type of batteries [1]. In this study, NFPP/C was synthesized by citric-assisted sol-gel method (as confirmed by X-ray diffraction and Infrared spectroscopy) to be transformed into its lithium analogue. For this purpose, 6 M $LiNO_3$ aqueous electrolyte was used and high intercalation ability for Li-ions was observed by both cyclic voltammetry and chronopotentiometry. On top of that, the comparative lithium and sodium storage properties of this 3D polyanionic NFPP/C framework will be presented and discussed.

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P.S.60.

Fractographic features of composite sucker rod fracture

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The research discusses the peculiarities of fatigue fracture of composite sucker rods used as a component of a lifting system in oil production. Using hybrid sucker rods with metal heads and a composite carbon fibre core with a fibreglass cover is promising since it can decrease a rod’s weight and significantly reduce corrosion loss. The main part of the body of such a rod is a carbon glass core with a diameter of 13 mm with a fibreglass shell of 3 mm thick. However, loading of composite sucker rods by rotating bending led to their damage in the form of longitudinal cracks. Their occurrence is caused by delaminations in the fibreglass shell resulting from uneven stress distribution in the rod’s cross-section. The fracture surface of the specimen made of a composite rod is inspected after its rotating bending under the stress of σ = 170 MPa; the number of cycles to fracture N was equal to 1.3×10^6. The surface layer of the specimen hardened by fiberglass filler is crucial for its fatigue life. The fracture of the specimen under cyclic loading initiates near its lateral surface from the delamination of a part of glass fibres in the rod’s shell due to a mismatch in their elasticity modules, which is confirmed by the presence of secondary cracks along the boundaries of the shell’s components. After cohesion disturbance between glass fibres and a polymer binder, the fibres deform independently from the matrix in each loading cycle until their final fracture by cleavage, forming a typical river pattern on their fracture surfaces. The next step of damaging is ductile stretching of partitions of the polymer binder between delaminated fibres until their tearing. The stress concentration in the tip of a fatigue crack, formed due to a gradual fracture of glass fibres and the binder, creates preconditions for fracture propagation deep into the rod's cross-section. The rod's core, reinforced with carbon fibres, breaks due to tension and is accompanied at the final stage by pulling out some of the carbon fibres from the polymer binder because of cohesion loss between them.

P.S.61.

Biodegradable mulch films obtained from unique combinations of cellulose, polycaprolactone, keratin and calcium carbonate

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Biodegradable mulch films from cellulose (CELL), cellulose/polycaprolactone (CELL/PCL), cellulose/polycaprolactone/keratin (CELL/PCL/KER) and cellulose/polycaprolactone/keratin/ground calcium carbonate (CELL/PCL/KER/GCC) were prepared using Ionic liquid as a green solvent. Pure cellulose biopolymer is characterised by better mechanical properties (tensile strength - force per unit cross-sectional area at breakage - of 75.3 MPa and modulus of elasticity of 944.4 MPa) than the other studied samples which is attributed to the formation of partially miscible polymer blends. Among samples containing PCL, CELL/PCL/KER/GCC has the highest tensile strength and modulus of elasticity. The addition of KER or KER/GCC to CELL/PCL films resulted in an increment in melting temperature and an improvement of sample crystallinity. The light transmittance of all films was >60 %. The incorporation of KER enhanced the biodegradability of the biocomposites, while KER/GCC addition slightly inhibited degradation due to an increased hydrophobicity and crystallisation growth of semi-crystalline biopolymers. The reported method for mulch film preparation is green and recyclable, and, when including a readily available source of KER, such as by extraction from waste chicken feathers, enables conversion to organic biofertiliser. The findings of this study contributed to sustainable agriculture by providing nutrients that enhance the growth speed of the plant, and hence food production, and reduce environmental pressure. Inclusion of GCC additionally provides not only Ca^{2+} for plant consumption but also soil pH control.

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P.S.62.

Study of the impact of reaction conditions on the kinetics of 2-methylquinoline over Ru-supported catalysts

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The heavy dependence on fossil fuels as the dominant energy source has led to substantial environmental deterioration and economic instability. Transitioning to efficient renewable resources brings its own set of challenges, particularly in terms of storing power generated consistently throughout the year. To overcome these challenges and facilitate the transition towards sustainable energy systems, it is crucial to prioritize the development of efficient energy storage solutions. Liquid Organic Hydrogen Carriers (LOHCs) have emerged as a promising class of organic compounds that offer potential solutions for hydrogen storage. One of the key advantages of LOHCs lies in their ambient storage capability, obviating the need for extreme temperatures and pressures typically associated with alternative hydrogen storage methods. Additionally, LOHCs exhibit notable advantages in terms of flexibility, scalability, and compatibility with prevailing infrastructure, making them an attractive solution for large-scale hydrogen storage. However, further research and development efforts are essential to optimize LOHC systems, enhance reaction kinetics, and explore novel LOHC materials. This study aimed to investigate the effects of various reaction conditions on the kinetics of the hydrogenation reaction of 2-methylquinoline, serving as a novel LOHC candidate, in the presence of Ru/Al_2O_3 and Ru/C catalysts. The reaction was conducted to evaluate the influence of temperature, hydrogen pressure, catalyst quantity, and stirring speed on the conversion of 2-methylquinoline. Experimental data were collected and subjected to analysis in order to construct a comprehensive kinetic model, facilitating the determination of reaction rates and activation energies for each step of the hydrogenation process.

P.S.63.

Effect of porosity on functional properties of $Ba_{0.85}Ca_{0.15}Ti_{0.90}Zr_{0.10}O_3$ ceramics for piezoelectric and pyroelectric energy harvesting applications

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The aim of this work was to combine the experimental results and modeling approach to provide a detailed examination of the influence of porosity volume fraction and morphology on the dielectric permittivity, polarisation-electric field, piezoelectric and pyroelectric response in Pb-free ferroelectric materials. Porous $Ba_{0.85}Ca_{0.15}Ti_{0.90}Zr_{0.10}O_3$ (BCTZ) lead-free ceramics were fabricated via the burn polymer spheres (BURPS) method by introducing poly(methyl methacrylate) (PMMA) particles as the pore-forming agent. Structural investigation has shown that the porosity-induced phase transition from orthorhombic to tetragonal phase. The low and high field dielectric properties have revealed that porous BCTZ ceramics (with 6 to 30% of porosity) present the gradual reduction of dielectric constant with increasing frequency indicating porosity as a result of the “dilution effect” due to the air pores, and a shift of Curie temperature due to the possible structural and strain modifications. The dielectric constant decreased with the increase in porosity which ultimately improved the piezoelectric and pyroelectric figure-of-merits (FOMs). Using analytical and numerical calculations for describing the formation of anisotropic porosity and strain distribution, it was shown that the specific porosity distribution determines specific strain stress distributions which may provide superior piezo and pyroelectric FOM.

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P.S.64.

Analysis of *local vs.* macroscopic properties of porous $BaTiO_3$ ceramics based on 3D reconstructed ceramic microstructures

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In the present work, ferroelectric $BaTiO_3$ ceramics with variable porosity (96, 89, 81, and 74 % relative densities) and anisotropy derived from the deformation of sacrificial soft polymeric additives during the pressing step, are investigated by an experimental-numerical approach. 3D micro X-ray computed tomography experimental data with specific numerical procedures are firstly used to reconstruct the 3D microstructures of the porous ceramics and to extract geometrical information concerning the samples. These 3D microstructures are then employed as input in FEM models, in order to determine the local electric field and potential distributions inside the ceramic, with the final aim of evaluating low field effective dielectric permittivity and high field ferroelectric switching P(E) features as a function of porosity and field direction. The dielectric and ferroelectric properties derived by using this procedure are discussed in comparison with experimentally determined ones. The paper demonstrates the usefulness of analyses and simulations of properties at different lengthscales, in such ceramic systems, in completing the understanding of the complex relationship between composition – microstructure – local/macroscopic properties.

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P.S.65.

Effect of grain size on the functional properties of 5%Zr-$BaTiO_3$ ceramics

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Size and scale dependent behaviors in ferroelectric materials attract considerable interest given the continuous trend of miniaturization in electronic industry. In addition to conserving the functional properties at values comparable to bulk material ones when reducing dimensions towards nanoscale, a particular interest regards the optimization of dielectric, ferroelectric and piezoelectric properties at some specific ceramic grain sizes. In the case of $BaTiO_3$ ceramics, the researchers dedicated mainly to the critical grain size (GS) of around 1 μm, where superior properties have been found, irrespective of the synthesis procedure and sintering method [1]. Studies on GS dependent properties performed in ceramics based on $BaTiO_3$ are scarce [2], with no critical size giving enhanced functional properties being reported. Therefore, this study is dedicated to the systematic investigation of 5%Zr-$BaTiO_3$ (BZT) ceramics with variable GSs, prepared through classical sintering, in order to check for a similar possible critical value characterized by enhanced properties. The BZT ceramic system displays a broad critical range of GSs (1.5 – 15 μm) with enhanced values of permittivity, in both orthorhombic and tetragonal phases. The room temperature P(E) hysteresis loops, together with the DC-tunability behavior, have been recorder for a maximum applied field of 30 kV/cm in order to assess the effects of GS variation. The piezoelectric characteristics have also been explored in the search of a critical GS or range of sizes characterized by superior property values.

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P.S.66.

Energy spectra and charge carriers thermodynamics in a model of high T_c superconductive ceramics

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High-temperature superconducting ceramics have "broken" the myth of an exclusively low-temperature effect of superconductivity. Although they were discovered and improved at the end of the last century, the mechanism of superconductivity has not been figured out to date. The biggest difficulty is their highly anisotropic and translatory noninvariant structure. The answer to the question of the oxide ceramics superconductivity mechanism must be undoubtedly sought in the phonon subsystem, in the elementary charge carrier subsystem as well as in the interaction of these subsystems. With regard to the very anisotropic structure of the superconductive ceramics, we have attempted to construct a theoretical model conveying the broken translational symmetry of atoms (molecules) arrangement along one direction in the crystal lattice, the difference of masses of these molecules and the presence of two boundary planes along this direction. The translational symmetry of the distribution of atoms (ions) of the charge system is broken by sputtering (doping) and due to the existence of two boundary surfaces. This is a model of high-temperature superconductors in which the observed symmetry breaking orthogonal to the CuO planes is treated as a perturbation. Single-particle fermion wave functions and possible charge carrier energies were determined. The competing existence of superconducting and normal regions in such a sample is shown in agreement with experimental data. The conditions for the formation of superconducting states and the limits of the current density values in the planes parallel to the boundary surfaces (in the CuO planes) were obtained and discussed. The electronic contribution to specific heat and entropy depends linearly on temperature, as in bulk structures, but with a different slope coefficient, so it follows that the electronic gas in films is a less ordered system and is closer to the equilibrium state than the same in bulk structures. These results provide an explanation for the experimental facts about the stronger superconducting properties of ultrathin thin films.

P.S.67.

Hydrogen peroxide decomposition by gadolinium orthovanadate nanocrystals

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Oxidative stress caused by an overproduction of reactive oxygen species (ROS) is the key factor in developing a variety of pathological conditions. Recently, various nanomaterials have attracted growing interest as nano-antioxidants with ROS-regulating ability. This work showed the high antioxidant behavior of $GdVO_4:Eu^{3+}$ nanoparticles revealed by spectroscopic methods and using ROS sensor and propose the mechanism describing their ROS scavenging action.

It was revealed that $GdVO_4:Eu^{3+}$ nanoparticles effectively scavenge hydrogen peroxide (H_2O_2). The investigation of absorption spectra of colloidal solutions of nanoparticles and XPS studies have shown that the decomposition of hydrogen peroxide is mainly carried out by electron capture by pentavalent vanadium ions, with their reduction to a 4+ and 3+ states. However, it cannot be ruled out that the decomposition of hydrogen peroxide occurs through a reaction in which it acts as an oxidant, oxidizing trivalent and tetravalent vanadium to a 5+ state.The catalase-like mechanism of hydrogen peroxide decomposition (without the formation of toxic hydroxyl radicals) as well as the effective neutralization of other types of ROS makes $GdVO_4:Eu^{3+}$ nanoparticles a promising material for the development of novel antioxidants.

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P.S.68.

High-resolution FEGSEM surface characterization of SPE-based sensors modified with polyaniline, carbon nanotubes and nanoparticles

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Sensors based on screen-printed electrodes (SPE) modified with different electrochemical mediators and nanomaterials were developed for detection of toxic organic compounds. Working electrodes (WE) of the SPE were upgraded with addition of polyaniline (PANI), carbon nanotubes (CNT), Pt nanoparticles on vulcan carbon and Au nanoparticles. Surface morphology and associated nanostructures of modified sensors were studied using high-resolution field emission gun scanning electron microscope (FEGSEM Verios G4 HP, Thermo Fisher Scientific). We have applied a dedicated SEM set-up with immersion lens mode, low-voltage operation at 2-4 kV and beam currents 20-50 pA. Secondary and backscattered electron images were recorded using through-the-lens detection (TLD, MD) at high magnifications up to 500.000×. In the case of beam sensitive samples, such as PANI on SPE, image acquisition was performed using drift-corrected fast-frame integration technique in order to avoid sample deterioration and damage. SEM micrographs clearly revealed nanoscale surface details and the distribution of modifiers on sensors WE surface. Sensors with PANI fibers decorated with 20 nm Au nanoparticles showed excellent properties for cycled NH_3 measurements. SPE electrochemical biosensor elements with addition of polystyrene (PS) spherical particles embedded in a PANI layer with dispersed Au nanospheres (PS-PANI-Au composite) provided high surface/volume ratio thus being suitable for detection of large amounts of biomolecules. SPE sensors where WE were modified with CNT and with Pt nanoparticles on vulcan carbon showed high sensitivity, low detection limits and selectivity for detection of endocrine disruptors and bisphenols.We showed that an optimized high-resolution FEGSEM microscopy with images being sensibly acquired at ultra high magnifications gave direct insight and clear evidence of the morphology and nanostructured details on the surface of modified WE in SPE-based sensors. This allows to take consistent control and make the optimization of the processing parameters in the research and production of SPE sensors for specific applications.

P.S.69.

Photocatalytic activity of nanocrystalline NiO-CeO_2 catalyst and its entropy-stabilized derivatives towards Azo dyes degradation

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The need for new materials with a wide variety of properties has increased in the past few decades. For this reason, our research has been focused on the complex mixed oxides having multifunctional properties. NiO-CeO_2 mixed oxide was prepared by the citrate route with nominal Ni/Ce molar ratio of 1.0. NiO and CeO_2 pure oxides were also prepared through the same procedure. We also introduced new elements by doping the parent structure, NiO-CeO_2, to increase the configurational entropy of the system. This approach was used in order to increase its stability and induce new properties. The obtained compounds were primarily characterized by X-ray powder diffraction (PXRD) and thermogravimetric analysis (TGA). Band gaps were calculated from UV/Vis absorption spectra using the Tauc method. Band gap values were in the range of 5 to 6 eV, which is roughly in the semiconductor area. Specific surface area and pore size distribution were determined by physisorption measurements. The oxygen mobility of compounds was tested by isotope exchange of their oxygen with $^{18}O_2$ and $C^{18}O_2$ in temperature-programmed modes. The photocatalytic activity of synthesized compounds towards the degradation of methylene blue (MB), rhodamine B (RDB), and naphthol green B (NG) was monitored by UV/Vis spectroscopy. The magnetic behaviour of the mixed oxide NiO-CeO_2 differs significantly from magnetic properties of CeO_2 and NiO nanoparticles. A much larger splitting between zfc and fc susceptibility and hysteresis with a coercive magnetic field of 600 Oe and a remanent magnetization of 0.02 emu/g, are clear evidence for a ferromagnetic order in the NiO-CeO_2 mixed oxide.

P.S.70.

The final step of TEM sample preparation using NanoMill (precision ion polishing technique)

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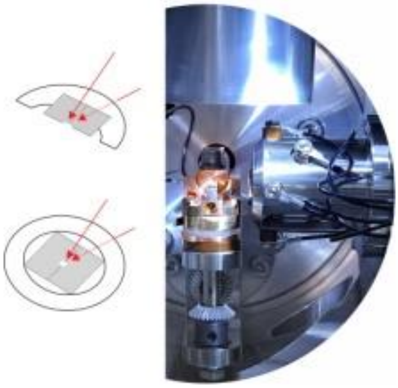
New materials (ceramics, thin films, composite, etc.) that are coming have specific properties and have to be precisely treated. This poses ever-new challenges, constant adjustments, and improvements in a TEM sample preparation technique. In this chapter, we compared two different TEM sample preparation techniques; the conventional TEM preparation technique and the tripod technique. All samples have been post-treated using Nanomill® (model 1040, Fischione Instruments, Inc.) as a final step of TEM preparation. For the final step of TEM samples, we study two different approaches on the same sample composition. The samples were metal and metal oxide deposited in a Sputron triode sputtering system (Balzers, Oelikon)[1]. Sample was cut into a block, and mounted face-to-face with epoxy glue. After this step, two different approaches were used. For the first sample, we used the conventional TEM sample preparation technique. The sample was ground down to a thickness of 100 µm and dimpled down to 15 µm at the disc center and finally ion-milled using 3kV Ar^+ ions until perforation. The second sample was a tripod-polished sample with a beveled thin slice. The sample was polished on a low angle (>1°), resulting in a quality surface whose wedge edge is electron transparent. Both samples were finally treated with NanoMill using carefully selected ion polishing conditions (energy, emission, point of interest, ...).The final step in every type of preparation nowadays is crucial and affects the final result. With this study, we demonstrate how important is to know different techniques for TEM sample preparation and how precisely the final step, of precision ion milling, improves the quality of the sample for further advanced analytical analysis.



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P.S.71.

High-energy mechanical milling-driven volumetric nanostructurization in glassy-crystalline arsenoselenidesprobed byannihilating positrons

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Positron annihilation lifetime (PAL) spectroscopy in the modified *Positronics*approach is first employed to study volumetric nanostructurization effects in arsenoselenide compounds at the border of glass-forming region exemplified by melt-quenched $As_{65}Se_{35}$, $As_{70}Se_{30}$ and $As_{75}Se_{25}$ alloys subjected to high-energy mechanical milling (*nanomilling*) in dry and combined dry-wet modes. Glassy-crystalline nature of these specimens is confirmed by the X-ray powder diffraction analysis, showing domination of amorphous arsenoselenide phase modified by remainders of cubic arsenolite (As_2O_3) and rhombohedral arsenic (As) phases. The formalism of x3-x2-CDA (coupling decomposition algorithm) describing conversion of bound positron-electron (positronium, Ps) states in positron-trapping sites is applied to identify volumetric changes in pelletized PVP-stabilized nanocomposites in respect to dry-milled ones. Under transition from wet-milled to dry-milled probes, positron traps typical for dry-milled arsenoselenides with defect-specific lifetime of ~0.376 ns (corresponding to multivacancies in arsenoselenide matrix) appear instead of Ps-hosting holes stabilized mainly in PVP environment typical for wet-milled samples with Ps-related lifetime of ~1.730 ns, these changes being accommodated in oxidized matrix with character defect-free bulk positron lifetime approaching ~0.26 ns.

P.S.72.

Sustainable degradation of tolperisone hydrochloride from water and its environmental toxicity on development of barley

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The shortage of pure and sanitarily adequate water is a serious problem which affects both, the life quality and global economy. The pharmaceutically active ingredients are the most concerning pollutants. Tolperisone hydrochloride (TLP) is widely used in the treatment of different pathological conditions, such as multiocular sclerosis, myelopathy, and painful muscle spasms in orthopedic and rheumatologic diseases. Additionally, according to the European Directive 67/548/EEC, TLP is considered to be extremely harmful for aquatic ecosystems. Photocatalysis is a green and effective technique in the degradation of persistent organic pollutants, which application may solve the significant energy and environmental pollution crises by harvesting the renewable and clean solar energy. In this study, heterogeneous photocatalysis was used as a sustainable alternative for TLP removal from water. The degradation pathway of TLP was also analyzed using various scavengers and it was found that the contribution of reactive species changed in following order: $OH^{\bullet}_{free} > h^{+} >> OH^{\bullet}_{ads} > e$. In addition, the toxicity of TLP and its degradation intermediates were examined on barley, using chemometrics. The most significant variations were observed on barley plant after 4 days of germination and on the root, during the barley biomass production. The results also showed that TLP and its intermediates are harmful to the plants, due to deteriorating water uptake with toxic TLP-compounds that reach the vital parts of plants. Also, slightly variations in total nitrogen amount were observed. The high genetic variability efficiently guards barley from various environmental stresses.

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P.S.73.

The low temperature plastic deformation of ultrafine-grained Mg-Al-RE alloy processed by ECAP

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Nowadays, there is still a high interest in searching a way for improving mechanical properties of low weight materials for cryogenic applications. Perspective candidates for these applications are magnesium alloys containing rare-earth (RE) elements. The deformation behavior of fine-grained AE21 alloy (Mg-1.7Al-0.66Ce-0.36La-0.23Nd-0.18Mn-0.05Pr) under uniaxial tension was studied in the temperature range of 0.5-400 K using a special cryogenichigh-performance equipment. The change in the microstructure of the alloy was performed by equal channel angular pressing (ECAP). The modification of the alloy microstructure during 8 passes of ECAP occurred due to a decrease in the average grain size, the increase of dislocation density, the intermetallic phase precipitation and change of crystallographic texture. The mechanical behavior of the studied alloy has a number of features. At 400 K, the lowest value of the yield strength is observed, which is 70 MPa. The temperature decrease to 290 K leads to more than twofold increase in the yield strength. With a further decrease in temperature down to 0.5 K, the increase of the yield strength slows down considerably. It was shown that in the temperature range of 0,5-290 K the yield strength of the studied alloy varies slightly with temperature and is about of 170-200 MPa. However, ultimate strength and deformation to failure have a strong dependence on temperature. Thus, with decreasing temperature from 400 to 0.5 K the ultimate strength monotonically increases from 100 to 280 MPa. As the temperature decreases from 400 to 4.2 K, the strain to failure decreases from 20 to 3 %. At the same time, a further decrease in temperature to 0.5 K leads to a slight increase of the deformation to failure up to 4.5 %. Curiously, in the temperature range of 0.5 to 4.2 K an intensive low-temperature jump-like deformation is also observedand its activity increases with decreasing temperature. The received data are discussed in terms of the structure influence on the plastic deformation processes at low temperatures.

P.S.74.

Enhanced superconductivity and electron-phonon interaction in point contacts of trigonal $PtBi_2$

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$PtBi_2$ is a Weyl semimetal, which demonstrates superconductivity with low critical temperature T_c= 0.6 K in the bulk. Here, we report our study of electron-phonon interaction (EPI) in trigonal $PtBi_2$ by the Yanson point contact spectroscopy and present the observation of point-contact enhanced superconductivity. We show, that the Yanson point-contact spectra display a broad maximum around 15 meV, which dominates in EPI, indicating, apparently, the EPI mechanism of Cooper pairing in $PtBi_2$. Moreover, we discovered a substantial increase of T_c up to ~ 3.5 K in point contacts. The observed T_c is sufficiently higher than the bulk value, as well as detected one at hydrostatic pressure. We calculated the phonon density of states and Eliashberg EPI function in $PtBi_2$ within the framework of the density functional theory. A comparison of experimental data with theoretical calculations showed acceptable agreement. The estimated T_c from theoretical calculations is 3.5 K, what corresponds well to the experimental value.

P.S.75.

The microhardness of high-entropy $Co_{0.25-x}Cr_{0.25}Fe_{0.25}Ni_{0.25}C_x$ alloys in the temperature range 77 to 300 K

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The mechanical properties and the effect of carbon additions of high-entropy alloys $Co_{25-x}Cr_{25}Fe_{25}Ni_{25}C_x$ (x = 0, 1, 3, at.%) in two structural states, as-cast coarse-grained (CG) samples and nanocrystalline (NC) were investigated by microindentation in the temperature range of T = 77-300 K. The nanostructural state was obtained by high-pressure torsion method at room temperature. The microhardness of CG alloys at room temperature increased monotonically with increasing carbon concentration, while in NC alloys the maximum microhardness H_V was achieved at 1 at.% of carbon. The reason for this anomalous behavior of the microhardness of NC alloys is an increase in the grain size and a decrease in the dislocation density in the alloy with x = 3 compared to the alloy with x = 1. As the temperature decreased from room temperature to the temperature of liquid nitrogen, the microhardness of CG and NC alloys increased by about 1.5-1.7 and 1.2-1.5 times, respectively, which indicates the thermally-activated nature of plastic deformation under the indenter. The results obtained indicate that the main role in the hardening of the CG alloys $Co_{25-x}Cr_{25}Fe_{25}Ni_{25}C_x$ is due to solid solution and dispersion hardening, while in NC alloys it is hardening due to a decrease in the grain size (according to the Hall-Petch relation) and an increase in the dislocation density (according to the Taylor relation).

P.S.76.

Microwave eccentric spherical cavities spectrum using local point-based boundary conditions method for eigenfrequencies

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The study of bulk microwave resonators with random inhomogeneities of shape or/and volume is an urgent problem because there is currently no strict theory that can describe electrodynamic processes in microwave resonators with random inhomogeneities. Spherical shape dielectrics have been studied in numerous papers. We present both a computational method and the theory it is based on, which allow calculating the frequency spectrum of axially symmetric resonators. In this report, we consider as an example a layered spherical cavity resonator with a constant permittivity of each layer. The permeability of the layers is equals unity. The considered resonator structure is surrounded by a perfect metal. To reduce the number of variables in the problem, the electromagnetic field in each layer is described using the Hertz functions in the form of a superposition of spherical waves — eigenmodes of the uniform spherical resonator. Moreover, each eigenmode of the system is presented as a sum of transverse electric (TE) and transverse magnetic (TM) components.The main feature of the proposed method is the way the boundary conditions (BCs) on the outer sphere are formulated. The BCs are stated at a given number of points on the boundary. At each of the points the physical requirements of vanishing of the tangential components of the electric field at the interface between a dielectric and perfect metal are fulfilled. The advantage of the developed method is the reduction in the required computing resources. In addition, the proposed approach allows one to separate *a priori* the degenerated resonances in the spectrum. This avoids difficulties related to rounding errors for close eigenfrequencies when computing the statistical properties of the spectrum and studying the wave chaos in the system.

P.S.77.

Magnetically-controlled composites with amino-/mercapto- polysilsesquioxane coating for doxycycline sorption

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Tetracyclines are among the cheapest antibiotics and rank second in terms of production and use in medicine, animal husbandry and agriculture worldwide [1]. They are usually poorly assimilated and excreted with waste products into the aquatic environment, ending up in the soil, leaching into the groundwater and entering drinking water. Accumulation of antibiotics in the environmental objects is harmful for living organisms, can cause allergic reactions, dysbacteriosis or the emergence of antibiotic-resistant bacteria [2]. Namely, doxycycline refers to antibiotics used to treat bacterial pneumonia developing as a complication of COVID-19. In order to reduce the negative impact of doxycycline, it is necessary to control its emissions into wastewater by appropriate waste treatment and disposal of drugs. Also, methods of water purification from doxycycline can be used, for example, adsorption or membrane technologies. According to the World Health Organization, the permissible concentration of doxycycline in drinking water is 0.1 μg/L. Our previous research revealed that magnetically-controlled materials combining amino and mercapto groups in the surface layer proved to be efficient sorbents of heavy metal ions and organic molecules, such as dyes [3]. To study the adsorption of doxycycline, we used composites containing a magnetite core, and the polysilsesquioxane shell formed with the participation of bridging silane with phenylene groups and the functional silanes with amino or mercapto groups, or their combination. Such composites have a developed porous structure (S_{BET} = 236-980 m^2/g) and a high content of functional groups (up to 2.5 mmol/g). The dependence of doxycycline sorption on contact time and concentration was investigated. It was demonstrated that the SH- and NH_2-containing samples removed 6 and 14 mg/g of doxycycline, while the bifunctional SH/NH_2 sample showed the highest value of adsorption capacity to doxycycline, 20 mg/g and the equilibrium was set within 20 min. Thus, such composites are highly effective materials for extracting antibiotics from water.

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P.S.78.

Microstructural changes of LC^3 on early-age carbonation curing at various temperatures

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The concrete carbonation curing (CO_2 curing) technique is nowadays receiving increased attention as a promising technology to reduce atmospheric CO_2 and significantly improve the concrete's properties. Concrete that has undergone CO_2 curing experiences quick chemical reactions between the calcium-bearing phases and CO_2, accelerating the development of the concrete's strength and shortening the curing time. The purpose of this study was to determine the effect of temperature on the carbonation process and microstructure of CO_2 cured LC^3, where a part of the ordinary Portland cement (OPC) clinker is replaced by a combination of limestone and calcined clay. The temperature effect on the hydration and carbonation reactions, pore network of the cement paste, as well as morphological changes, size, and amounts of calcium carbonate polymorphs was studied. For the LC^3 two types of technical grade clay minerals, kaolinite and montmorillonite, which differ in their Si/Al ratios, were studied. Replacement rate of cement clinker with calcined clay and limestone used in the LC^3 was 50 wt.%. Prior to CO_2 curing, the samples were pre-conditioned in a humidity chamber at a temperature of 20 ± 2 °C and 95 % relative humidity. The samples were placed in a CO_2 chamber in which the relative humidity and CO_2 concentration were maintained at 60±5 % and 20±2 %, respectively, with temperatures at 10, 20 and 60 °C. After the 1st day of carbonation curing, pastes were cured at 20±2 °C and 95 % relative humidity up to 28 days. Changes in microstructure and composition of the hydration products were observed at different time periods of early-age carbonation curing using scanning electron microscopy (SEM) with energy dispersive X-ray spectroscopy (EDS). The phase evolution of the LC^3 pastes during CO_2 curing was studied by X-ray powder diffraction (XRD) with Rietveld refinement method. Thermogravimetric differential thermal analysis (DTA/TG) was also carried out in order to support and complement the identification of hydration and carbonation products determined through XRD. Pore structure (mercury intrusion porosimetry) and compressive strength were determined at 1 day and 28 days to investigate influence of various carbonation curing temperatures on paste properties. Temperature effected amounts and types of the hydration and carbonation products which influences compressive strength.

P.S.79.

Hydrogenation properties of the Ni-Co nanostructured materials

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Positive size-effect on the catalytic and hydrogen storage properties of nanostructured materials has been studied intensively. Recently we reported the effective catalytic influence of Ni-Co nanopowders were demonstrated for hydrogen generation by $NaBH_4$ hydrolysis reaction [1]. Besides, the results of investigations of the electrochemical hydrogenation of bimetallic Ni-Co nanoparticles obtained via the reduction of Ni^{2+} and Co^{2+} by hydrazine [2]. Positive effect of nano-sized transition metals as additives on the properties of negative electrode materials for Ni-MH batteries was expected also. The positive role of nano-sized nickel can be deal with its own hydrogen sorption ability [3]. In our recent studies the critical dependence of the hydrogenation properties of the nickel-based nanopowders from the size and structure of the particles has been demonstrated. We synthesized mono- and bimetallic Ni-Co skeletal nanostructures obtained by the leaching of Al from the Ni/Co/Al alloys. The structure of the obtained materials was carefully investigated using XRD, SEM, TEM, SAXS and low-temperature gas adsorption techniques. Gas and electrochemical hydrogenation (discharge capacity, cyclic stability, voltamperometric curves, etc.) of obtained nanomaterials were investigated. It was shown that the discharge capacity of the nanopowders depends on the chemical composition and, most importantly, from the fine structure of the particles. The cycling stability of Ni-Co bimetallic nanopowders, especially for the obtained via the reduction of the mix of Ni^{2+} and Co^{2+}, is insufficient. Thus, in this report we will present the results of the comparative investigations of the hydrogenation properties of different two component Ni-Co nanostructured materials as well as those doped with 10 at.% Pd.

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P.S.80.

Photoluminescent properties of C_{60} fullerite intercalated with N_2 and H_2 molecules in a wide temperature range.

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The optical properties of C_{60} single crystals saturated with hydrogen and nitrogen molecules were studied by the spectral-luminescence method in the temperature range of 20–230 K. The saturation was carried out under a pressure of 30 atm at different temperatures from 200 to 550 °C. Early it have been established of C_{60} fullerite intercalated with H_2 [1] and N_2 [2] molecules that the temperature limit of the adsorption crossover is about 300 and 420 °C, respectively (transition from the diffusion mechanism of intercalation - physisorption to chemical interaction - chemisorption). At saturation temperatures higher than this temperature limit the process of chemical interaction of H_2 or N_2 impurity molecules and the C_{60} matrix occurs with the formation of a new chemical compound - $C_{60}Hx$ and $(C_{59}N)_2$. For the first time we present the results of the photoluminescent properties of new C_{60} fullerite intercalated with N_2 and H_2 molecules - hydrofullerite $C_{60}Hx$ and biazafullerite $(C_{59}N)_2$. In $C_{60}Hx$ compound the integrated radiation intensity is independent from temperature has been recorded. This behavior of integrated radiation intensity have been explained by the absence of an orientational phase transition and the transition to a glassy state in this compound. In biazafullerite $(C_{59}N)_2$ the temperature dependence of the integral radiation intensity has been registered. Also in this compound the low temperature quenching of photoluminescence has been detected. The new effect of low-temperature quenching of photoluminescence has been explained by the appearance of effective capture centers of the excitons which occurs as a result of the chemical interaction of N_2 impurity molecules and the C_{60} matrix, and the non-radiative deactivation of electronic excitation [3].

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P.S.81.

Electrochemical detection of chloramphenicol drug based on ZnO and ZnO/graphene oxide composite nanoparticles

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The release of pharmaceuticals in the environment represents a significant ecological problem due to their complex structure making them challenge to be decomposed and removed by standard waste-water treatment processes. Zinc oxide (ZnO) represents a semiconductor compound with exceptional optical and electrochemical properties, chemical and photochemical stability, non-toxicity, biocompatibility, etc. Due to their adjustable multifunctional properties, ZnO based materials have concerned general scientific and technological attention. Nowadays these materials are used for a range of applications in electronics, opto-electronics, biosensing**,** bioimaging, drug delivery, antimicrobial and anticancer agents, implants as well as sensing in environmental applications. The main object of this study was to improve efficiency of ZnO particles toward electrochemical sensing of water pollutants and electrocatalysis. In order to modify electro-chemical properties, zinc oxide/graphene oxide (ZnO/GO) composites with different ZnO:GO weights ratio were prepared using a microwave (MW) assisted synthesis of precipitate. Two different amounts of GO (0.1 and 0.5 wt.%) were dispersed in 100 mL of distilled water. After stirring for 5 min an appropriate amount of $ZnCl_2$ was added to the GO water dispersion. Subsequently, 20 mL of 1.75 M NaOH was added dropwise to the mixture with constant stirring. After being stirred at 50 °C for 90 min in total, the as-prepared precipitate was microwave processed in a MW oven (2.45 GHz, 130 W) for 5 min. After cooling to room temperature, the precipitate was centrifuged and rinsed to remove the surface residues of the starting chemical solutions. The synthesized powder was dried in an oven at 80 °C for 24 h**.** The particles crystal structure and phase composition were investigated by X-ray diffraction and Raman spectroscopy. The particles morphology was determined with FE–SEM. The optical properties were studied using UV–Vis DRS and PL spectroscopy. The electrochemical sensing activity of ZnO and ZnO/GO electrodes was tested for detection of chloramphenicol water solution whereas electrocatalytic activity was tested for water splitting when samples were used as anode materials and evaluated by linear sweep voltammetry in 0.1M NaOH and 0.1 M H_2SO_4 electrolytes. ZnO/GO electrodes were tested as-prepared and after in situ reduction of GO at -1.4 V *vs.* SCE in 0.1 M KCl. Electrochemical activity of prepared composites was correlated with the presence of GO and reduced GO particles.

P.S.82.

Modification of MoS_2/GO composites with ball milling and thermal treatment for catalytic application

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Hydrogen production can be outlined as an important aspect of the modern economy. In order to be more clean and renewable, green hydrogen is most desirable, where expensive catalysts for water electrolysis are usually used. As alternative, transition metal dichalcogenides represent potentially good material, with room for further improvement. Molybdenum disulfide is a stable material with a reasonable amount of it available. The properties of the material can be easily tuned in order to increase its charge transport and create more active sites. The incorporation of defects and additives can be beneficial for the catalytic activity of MoS_2. Graphene oxide (GO) is carbon nanomaterial, with a large surface area and when reduced, it could be used as a conductive additive. Furthermore, ball milling is a known low-cost, simple and scalable method to introduce defects in the structure. Therefore, combining these two approaches should result in a material with enhanced catalytic activity for hydrogen evolution reaction. The molybdenum disulfide was prepared by easy one-step hydrothermal synthesis. The graphene oxide was first obtained by modified Hummers' method and after that reduced by thermal treatment at 200 °C. Thus prepared constituents are combined in different mass ratios and composites were obtained by milling with a high-energy ball mill. The various milling parameters were optimized. The prepared composites were analyzed as catalysts for hydrogen evolution reaction in an acidic solution.

P.S.83.

Physicochemical properties of solvothermaly synthesized zinc copper ferrite nanoparticles

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In the past two decades spinel ferrites nanoparticles have been extensively investigated due to their potential applications in a variety of fields (data storage, catalysis, energy, environment, biomedicine, etc.). In the present work, zinc ferrite nanoparticles with different copper content ($Zn_{(1-x)}Cu_xFe_2O_4$; x=0, 0.2, 0.4, 0.6, and 0.8) but with the same particle size distribution and amount of oleic acid as capping agent were prepared by solvothermal synthesis and the physicochemical properties of as-prepared samples were investigated. The prepared samples were characterized by X-ray powder diffraction (XRD), transmission electron microscopy (TEM), Fourier transform infrared spectroscopy (FT-IR) and vibrating sample magnetometry (VSM). The XRD results show that all the diffraction maxima correspond to the cubic spinel structure, while TEM images reviled that samples are consisted of sphere-like particles, 5-7 nm in size. The presence of oleic acid on the surface of nanoparticles was confirmed by FTIR analysis. The magnetic measurements revealed superparamagnetic behavior of obtained powders, with gradual increase of saturation magnetization.

P.S.84.

Anomalous chain confinement in chain-walking-polymerized polyethylenes as seen by advanced NMR crystallography

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Polyethylene (PE) chains in solid state occupy mainly trans and two kinds of gauche conformations, between which there is a little energy difference. Therefore, the polymer adopts different structures under different conditions. Linear PE in solid state has three crystalline phases: orthorhombic, monoclinic and triclinic. There are also non-crystalline and interfacial phases, and their existence strongly affects the physical properties. In polymer chemistry, chain-walking (CW) polymerization is a revolutionary concept leading to a dendritic type of branching. This process is characterized by an accurate control of polymer architecture and topology. The polyethylenes used in this work were synthesized with α-diimine palladium and α-diimine nickel catalysts, when the former one exhibits higher propensity to CW, whereas the Ni one undergoes CW in less extent. The polymer chain arrangements and energies of intermolecular interactions stabilizing the anomalous structures were investigated by advanced approaches of NMR crystallography. Comprehensive analysis of a wide range of solid-state NMR spectra unveiled extensive structural diversity of CW-polymerized PE chains. The observed structural differences are associated with significant differences in segmental dynamics and polymer chains arrangements. Depending on the used catalytic systems the resulting polymer exhibited domain-like morphology with crystalline domains surrounded by partially ordered amorphous, unusual proto-crystalline phase and weakly branched interface up to a hyper-branched gel-like fractions. Based on the newly developed combined experimental-computational strategy of NMR crystallography of polymers we described intermolecular interactions stabilizing the anomalous structures in proto-crystalline domains of chain walking polymerized polyethylenes.

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P.S.85.

Enhancement of g-C_3N_4 with sulfuric acid treatment for the photocatalitic reduction of Cr(VI)

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A potential visible light photocatalyst, g-C_3N_4, has attracted great attention due to its simple preparation, high stability, low cost and medium band gap (~2,7 eV) [1]. Nevertheless, mostly high recombination rate of electrons and holes limits its practical application. One of the methods for optimizing g-C_3N_4 properties is the acid treatment. It was reported that treating g-C_3N_4 with sulfuric acid leads to certain surface and possibly structure modifications, which would further enhance the surface functionality and provide better dispersion of metal/semiconductor nanoparticles when forming heterojunction [1]. Different researches showed that treating g-C_3N_4 with H_2SO_4 could increase the specific surface area, obtain more active sites, convert surface charge, anchor the -HSO_3 electronegative groups to boost electron migration and enhance the charge separation, exfoliate bulk g-C_3N_4 into the nanosheets, but also expand its band gap. In this work, g-C_3N_4 was modified with H_2SO_4, by adjusting acid/C_3N_4 ratio and other experimental conditions in order to produce protonated (P-C_3N_4) [2], sulfated (S-C_3N_4) [1] and exfoliated (E-C_3N_4) g-C_3N_4 [3]. The properties of the photocatalysts were studied by FESEM, FTIR, BET and DRS analysis, as well as by determination of the point of zero charge (pH_{PZC}) and the number of acidic and basic surface functional groups. Photocatalytic reduction of Cr(VI) was tested at a constant solution concentration (10 mg/l), at pH 3, under the simulated visible irradiation and in the presence of citric acid as a hole scavenger. It was determited that acid treatment led to the decreasing in the specific surface area, lowering the pH_{PZC}, slightly increased bandgap energy but also enhanced photocatalytic efficiency and the number of surface functional groups.

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P.S.86.

Biocompatible soil conditioners based on polysaccharide hydrogels filled with layered clays and biochar

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The need for new effective materials that can be used as soil conditioners is based on the global trend of soil quality deterioration combined with rapid population growth. This research is aimed at the development of biocompatible soil conditioners based on a network of natural polysaccharides filled with layered clays or biochar. The use of fillers of different structures creates prerequisites for obtaining a balanced multi-functionality, which includes sufficient mechanical strength, high swelling capacity, and additional adsorption properties towards pollutants such as heavy metal ions. The natural polysaccharides, namely sodium alginate, kappa-carrageenan and guar gum, were used for the synthesis of hydrogels. Layered clays (montmorillonite, laponite RD) or biochar obtained by the pyrolysis of straw were used as fillers. The relationship between biomacromolecules and clays structure, crosslinking condition and structural and functional properties of the synthesized hybrid hydrogels was estimated using X-ray diffraction, FTIR, SEM and differential scanning calorimetry techniques. Synthesized hybrid hydrogels show high water-retention properties (their swellingdegree reaches 160 g/g) and a sorption capacity towards Cd (II) (~115 mg/g). The influence of a complex of these features on the improvement of soil properties was confirmed by studies of wheat growth activity in the soil (Haplic Luvisol) contaminated with Cd (II) and under artificial drought using a Phytotron chamber. The biosafety of hybrid hydrogels in relation to seeds was proved by the Nelyubov method, which showed the same viability of pea seeds in the presence of hydrogels as in distilled water. Thereby developed hybrid hydrogels can be promising soil conditioners to solve various problems, including the adsorption of heavy metal ions and other soil pollutants.

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P.S.87.

On biological influence of wide range non-ionizing EM radiation and its bioresonance balancing prevention

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Research in previous decades indicates an important epigenetic role of stress (including the so-called EM smog from a number of electrical devices in a wider EM range) in the development of a number of psychosomatic disorders. Therefore, a correct and comprehensive discussion is needed about the non-thermal effects of EM radiation in all bands (from ULF through RF/MW) - which is opposed by powerful electrical and telecommunications lobbies, guided by radiation protection standards that are based solely on thermal influences. So, the efforts of mobile device manufacturers are in vain because the acupuncture system is extremely sensitive to very low radiation intensities through a system of non-threshold gap junction (GJ) electrical synapses that permeate the acupuncture system (as well as heart muscle, liver, smooth muscles, and neurons with electrical synapses). Therefore, this paper deals with the biological influence of non-ionizing EM radiation in wide frequency bands, with some bioresonant balancing preventive effects on the human body exposed to harmful influences of non-ionizing EM radiations.

P.S.88.

An artificially designed polypeptide based on elastin exon 26 primary structure showed enhanced thermo-responsive properties and improved cell adhesion

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Elastin is one the main structural component in tissues that undergo countless cycles of expansion and contraction during a lifetime of Vertebrates. For this reason, it represents a valuable model to get inspiration for the design and realization of biomaterials with advanced functionality and properties. The Elastin-like Polypeptides (ELPs) are recombinant proteins based on the VPGVG repeats that are found in the bovine homolog. With the aim to realize something in-between a protein and a polymer, a biomimetic elastin was produced in our lab, selecting the exon 23 - 24 aminoacidic sequence of the human elastin as the basic monomer to be reiterated. This recombinant biopolymer alternating cross-linking domains and repeated hexapeptidic - VAPGVG- stretches characterizing the human homolog was named Human Elastin-like Polypeptide (HELP). The HELP and the derived materials showed no pro-inflammatory activity and good cytocompatibility, however, cell-type dependent adhesion on HELP-based substrates was observed. Moreover, some issues may arise because the HELP elastin-like domains, being peculiar of the human homologue, may elicit an immune response in other organisms where this sequence is not present, like in the animal models commonly used to evaluate the compatibility of biomaterials. For the above reasons, the design of a new sequence was undertaken, aligning several Vertebrate elastin amino acid sequences. The most conserved domain corresponded to a region of the exon 26 of the human homologue. Thus, we substituted the elastin-like sequence of HELP with the nonapeptidic repeats inspired to the conserved domain, resulting in a new elastin-like recombinant biopolymer named “universal” ELP (UELP). The new synthetic gene was assembled and recombinantly expressed. The UELP thermo-responsive behavior was analyzed and compared to that of HELP. Interestingly, accentuated inverse transition properties were observed as well as the improvement of cell adhesion on surfaces coated with this new biopolymer. These results show that the design of recombinant components following a biomimetic strategy represents a versatile and valuable tool toward the development of multi-functional smart materials.

P.S.89.

Thermal characterization of bioactive polyphosphate glass with strontium addition

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Polyphosphate glasses are a class of bioactive glasses that have gained significant attention in recent years due to their unique properties and potential applications in various fields, particularly in the area of biomedical engineering. These glasses exhibit excellent biocompatibility, which is a crucial requirement for biomaterials. Furthermore, their dissolution and degradation rates can be tailored by modifying their composition, allowing for control over their bioactivity and biodegradability. Polyphosphate glasses also have the ability to form a hydroxyapatite-like layer on their surface when in contact with biological fluids, which facilitates their integration with surrounding tissues. The unique properties of polyphosphate glasses make them promising candidates for various biomedical applications, including bone tissue engineering, drug delivery, and wound healing. This paper presents the thermal characterization of two bioactive polyphosphate glass compositions with the addition of strontium, to investigate the sintering and crystallization processes. The samples were synthesized using the melt-quenching method and then sintered at various temperatures. Differential scanning calorimetry (DSC) and X-ray diffraction (XRD) were used to analyze thermal behavior and crystalline phases formed during sintering. Our results showed that sintering and crystallization are separate processes for both compositions. The addition of strontium to the glass improved its sintering behavior, resulting in a more dense glass structure. Moreover, strontium incorporation did not affect the formation of the crystalline phase during sintering. These findings provide useful insights into the design and development of bioactive polyphosphate glass compositions for bone tissue engineering applications.

P.S.90.

Biological and bioinspired structures for multispectral surveillance

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There is a constant competition among living creatures, forcing them to “invent” a plethora of mechanisms to improve their security within the natural environment. Millennia of evolution have developed really remarkable mechanism still ahead of the existing technologies: acoustic stealth technology of some moths, invisibility of various butterflies (e.g. Greta oto), super-hydrophobicity of many bugs (Coleoptera) and butterflies (Lepidoptera). Security needs in a human society have equally stimulated development of novel technologies. Signal detection in the invisible parts of the electromagnetic spectrum (ultraviolet (UV), infrared (IR) and teraherz (THz)) is one of them, particularly interesting both for wartime and peacetime applications. It is well known that illegal activities, such as smuggling and trafficking, can be efficiently prevented by their detection using invisible radiation. A number of imaging system operating in the invisible has been devised, based on focal point arrays (FPA) - pixelated detectors used in contemporary imaging systems. The aim of the research is to develop a proof-of-the-concept multispectral surveillance system, inspired by, evolutionary optimized, nano- and micro-structures of insect wings. Compared to existing systems, which are restricted to narrow spectral bands, the proposed system will cover ultraviolet (UV), visible and infrared (IR) radiation. Micron-sized particles with internal nanostructures, similar to butterfly wing scales, will be used as sensing elements. Radiation-induced perturbations will be amplified by the interaction with the surrounding gas and detected by sensitive holographic techniques.

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P.S.91.

Fabrication of electrochemical immunosensors based on ZnO nanostructures

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Over the years, semiconducting metal oxides have found application in different areas such as high-performance electronics, energy conversion/storage, and immunosensors. Among the various metal oxide materials, ZnO has attracted considerable attention in immunosensor-related research due to unique semiconducting properties, such as high exciton binding energy and wide band gap (3.3 eV), which can be tuned in the range from 2.1 to 3.5 eV. Moreover, the high value of ZnO isoelectric point (IEP ~9.1-9.5) makes ZnO nanostructures attractive for the immobilization of biomolecules on their surface. In this work, various ZnO nanostructures were synthesised and characterized by different techniques. The synthesized ZnO nanomaterials were applied in the fabrication of immunosensors, and the electrochemical performance of the resulting immunosensors was evaluated.

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P.S.92.

AgNPs stability after different post treatment

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Silver is an effective agent to prevent and deal with bacterial infections. Among different types of silver, silver nanoparticles (AgNPs) are unique materials that find specific niche in biology and medicine. Nano-dimension, shape and high surface area increase the antibacterial properties of the NPs. Some applications of AgNPs require additional treatment like ultrasound, washing, and multiple dilutions. Therefore, nanoparticles should have the ability to maintain their original properties under different treatment. Our research aims to evaluate the stability of AgNPs with different post-treatment. AgNPs (provided by Nano Pure Co., Poland) were used in this study. Ag NPs suspension (3000 μg/mL) was centrifuged, whereas the supernatant was separated (transferred). Then the pellet was resuspended in distilled water to obtain stock concentration. The procedure was repeated three times. The investigation by the dynamic light scattering method allowed us to determine the distribution of the optical size of nanoparticles after water washing. Water washing resulted in the diminished optical size of the NPs. Populations of the washed NPs contained minor fractions (about 10 %) of large aggregates, which most probably could be attributed to the incomplete resuspension of the NPs after pelleting.Obtained results suggest that the washed-out NPs display abilities be in suspension after long water treatment. And smaller particle size could be associated with high reactivity.

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P.S.93.

The effect of anticeptic cationic gemini surfactant decamethoxin on the keto-enol tautomerism of curcumin in the preparation of nanobiocomposites

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Solubilization of curcumin (Cur) in surfactant micelles and, accordingly, incorporation into hydrophilic nanostructures is a promising way to increase its bioavailability, as well as prolong its therapeutic effect. Therefore, the aim of the work was to study the effect of the cationic hemini surfactant decamethoxin (DM) in a wide range of concentrations on the solubility and tautomerism of Cur in aqueous solutions. It has been found that the solubility of Cur increases by 2 orders of magnitude in an organized micellar medium of cationic dimeric surfactant. The solubilization capacity of DM with respect to Cur (0.044) and the binding constant of Cur with decamethoxin (lgKb = 4.47) were determined by the solubility method. Found values exceed significantly the corresponding values for monomeric surfactants. It was detected the effect of DM concentration on the keto-enol tautomerism of Cur and shown that Cur dissolves in water and diluted aqueous DM solutions mainly in the ketone form, and in micellar DM solutions only in the enol form. Quantum-chemical calculations of the Gibbs free energies of various Cur tautomers, taking into account solvation, as well as their change upon interaction with DM, confirm that the existence of Cur -keto is thermodynamically more favorable in an aqueous solution, while the interaction with DM leads to stabilization of the enol tautomer. Comparison of the ratio of Cur tautomeric forms in solutions of DM and in water-ethanol mixtures with a known permittivity, made it possible to estimate the polarity of the medium at the localization site of the Cur molecule in the micelle, which turned out to be significantly lower than in water. The results obtained can be used to create new effective drugs due to the found significant increase in the solubility of Cur and, accordingly, its bioavailability in the presence of DM, as well as the possibility of regulating the content of tautomeric forms of Cur with different pharmacological activity.

P.S.94.

Cell toxicity and antibacterial properties of NiTi metal alloy after plasma electrolytic oxidation.

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Nitinol is a shape memory alloy composed of nearly equal parts of nickel and titanium. It exhibits unique properties such as super elasticity and shape memory, making it an ideal material for vascular stents. It enables the stent to adapt to changes in the vessel diameter due to pulsatile blood flow and arterial movement. This flexibility helps prevent stent fractures and enhances long-term durability. But it is required to provide additional surface functionalization to enhance the stent epithelization and decrease the in-stent restenosis. In this study, we proposeto apply plasma electrolyte oxidation (PEO) to provide the formation of the bioactive surface of nitinol. We investigated the adhesive and proliferative properties of nitinol samples after PEO treatment. The PEO process of NiTi alloy was performed in H_3PO_4 and ethelenglycol solution (voltage – 70, 80, 90, 100 V, current density – 200 mA/cm^2). Determining the colony count was carried out using the streak plate technique at different time intervals of incubation (2, 4, 6, and 8 h) in the suspension of *S. aureus* and *E. coli* (final density of 1×10^5 colony forming units (CFUs)/mL) after ultrasonication of the samples. Human dermal fibroblasts (D6P13) adhesion and proliferation (cell culture density of 2×10^4 cells per well) was assessed by the resazurin colorimetric assay using a plate reader at wavelengths of 570 and 600 nm at different time intervals (1 day, 3 days and 7 days). As a result of our research, we have obtained a bioactive surface of nitinol samples after PEO treatment with good adhesive properties but poor proliferative activates.

Acknowledgment: This research is supported by M-ERA.NET Call 2020 project “Hybrid Biodegradable Coating for One-Wire Peripheral Nitinol Stent for Prevention of Restenosis and Plaque Formation” (HybbiStent)

P.S.95.

Towards new approaches for ultraviolet sterilization of MXenes

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Ultraviolet germicidal irradiation (UVGI) is a disinfection method that uses short-wavelength ultraviolet light to kill or inactivate microorganisms by destroying nucleic acids and disrupting their DNA. UVGI is used in a variety of applications, such as food, surface, air, and water purification. Exposure to ultraviolet light can enforce the oxidative degradation of $Ti_3C_2T_x$ Mxene inducing the formation of reactive oxygen species (ROS). UVGI proved practice-based evidence to control of microbial growth but the sterilization of MXenes by ultraviolet has not yet been studied. Our experiment was targeted to determine the effectiveness of ultraviolet for sterilization of MXenes on practice-based evidence to control bacterial growth. Ti-based MXenes (Ti_3C_2) (size of 1-3 µm) was used for assessment of bactericidal effect of UV on bacteria. MXenes in concentration of 4.4 mg/mL and bacterial suspension of *E. coli* and *S. aureus* (10^5CFU/mL) were mixed in ratio 1:1. Determining the colony count (CFU/mL) was carried out to evaluate bacterial growth at different time intervals of ultraviolet treatment (0, 5, 10, 20, and 40 min). The ultraviolet lamp with a power of 30 W was placed under 30 cm of the 24-well plastic plate with tested samples. After 40 min of UV treatment of MXenes in bacterial suspension, *S. aureus* growth was at 10^2 CFU/mL. A bacterial effect on *E. coli* was observed at 40 min after UV exposure. Control samples (bacterial suspensions without MXenes) verified bactericidal outcome after 5 minutes of the experiment. Ti_3C_2MXene has strong absorption in UV range (electronic transitions) therefore UV light cannot penetrate the MXene suspension that protect bacteria DNA from UV light. Taking into account the UV absorption properties of MXenes, UVGI cannot be used for Ti_3C_2 sterilization in suspension.

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P.S.96.

Effect of various supported catalysts on selectivity and conversion of biomass-derived glycolic acid

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Glycolic acid (GA), an α-hydroxycarboxylic acid, is a bifunctional molecule that mostly finds its use as a precursor for biopolymers, while also showing great potential as a platform chemical. It can be obtained from biomass through various biotechnological or catalytic processes, while its further upgrading recently has been heavily investigated under heterogeneously catalyzed hydrogenation reactions. Ruthenium, platinum, palladium, and other supported metal catalysts have shown great potential with conversions and selectivity over 90 %, towards production of bio ethylene glycol (EG), another important biopolymer precursor as well as additive for various consumer products (antifreeze, brake fluids, cosmetics, solvents, paints). This study will provide detailed investigation of the reaction mechanism of biomass-derived glycolic acid hydrogenation to ethylene glycol, over various carbon-supported noble-metal catalysts, involving all the intermediates and various potential routes. Reactions involving hydrogenation, deoxygenation, and decarboxylation have been shown to be present over various reaction conditions and various catalysts, whose correlation will be thoroughly described. Additionally, it will define the micro-kinetic model used to describe the three-phase system (gas-liquid-solid) with all the occurring heterogeneous reactions.

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Corrosion and scratch resistance of the nanotube layer formed on the titanium-based materials

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Titanium-based nanotubelayer was formed through the electrochemical anodization technique on coarse-grained and ultrafine-grained Ti-13Nb-13Zr (wt.%) alloy, in 1M H_3PO_4 + NaF electrolyte for 90 minutes. The nanotube layer morphology was analyzed using the scanning electron microscopy (SEM) and the X-ray diffraction (XRD). The electrochemical impedance spectroscopy (EIS) technique was used to determine the corrosion resistance of the alloy before and after electrochemical anodization. These materials were exposed to a solution simulating conditions in the human body (Ringer's solution) with pH of 5.5 at a temperature of 37 ºC. In order to investigate the titanium-based nanotube layer adhesion on alloy surface a scratch test was done. The scratch test was performedon nanoindenter G200, Agilent Technologies, using an indenter Berkovich-type diamond tip with applying an increasing load up to 40 mN. It was established that electrochemical anodization led to the formation of the nanotube oxide layer on the surface of titanium-based materials. Influence of the ultrafine-grained material structure on the homogeneity of the nanotube layer obtained by electrochemical anodization has been noticed. Both coarse-grained and ultrafine-grained alloy showed excellent corrosion resistance in Ringer’s solution. Moreover, electrochemical anodization led to a decrease or an increase of the corrosion resistance of these materials, depending on the nanotube layer morphology. The scratch test showed that plastic deformation was present in the nanotube layer. The scratch resistance for the nanotube layer failure was on the higher load, pointing to the good adhesion for the titanium-based nanotube layer formed using electrochemical anodization.

P.S.98.

Alginate/pectin beads with self-emulsifying system for controlled release of natural lipophilic molecules

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Due to their unique properties, polysaccharide biopolymers are at the forefront of interest in the formulation of innovative drug delivery systems for the treatment of the intestinal mucosa. Gastrointestinal (GI) diseases and digestive disorders are widespread. The gold standard therapies are usually antibiotics and corticosteroids. Therefore, there is a growing interest in finding new alternatives to the "gold standard" therapies for GI diseases. Due to its broad spectrum of biological activities, thymol, the phenolic terpene derived from *Lamiaceae* sp. is a promising candidate for topical treatment of the intestinal mucosa. Its limitations, such as volatility, lipophilic character and partial absorption in the stomach, could be overcome by incorporating it in the solid self-emulsifying gastro microbeads. Self-emulsifying alginate/pectin (ALG/PEC) beads cross-linked by polyvalent ions Ca^{2+}; Zn^{2+} (and their mutual combination) with thymol were prepared. The aims of our work were to study in detail the local structures of the alginate/pectin chains induced by different cross-linking ions at atomic resolution and to investigate these beads as a potential dosage form for colon therapy. By applying a series of advanced solid-state NMR spectroscopy techniques, we verified the distribution of cross-linking ions in alginate-pectin gels and a high degree of ion exchange. Applying the statistical data treatment procedure by Factor Analysis (FA) to the recorded ^{13}C CP/MAS NMR spectra of the prepared samples, we also found out a multi-component character of polysaccharide gels caused by the different binding alginate and pectin.

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P.S.99.

Material analysis using accelerated ion beams

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Ion beam analysis (IBA) methods and techniques utilizing accelerated ion beams at Jožef Stefan Institute in Ljubljana, Slovenia, cover a variety of possibilities for material research by exploiting specific phenomena from interaction of an accelerated particle with material in question. IBA techniques most frequently used are proton induced (X-ray / Gamma) emission (PIXE) / (PIGE), scanning transmission ion microscopy (STIM), Rutherford back-scattering spectroscopy (RBS), nuclear reaction analysis (NRA) and elastic recoil detection analysis (ERDA). These methods have been successfully used in many research projects over the last years. PIXE and PIGE techniques have been used for elemental analysis for investigation of Roman imperial vessels and window glass from Mt. Kosmaj, Serbia (Moesia Superior) [1], for analysis of early byzantine glass from Jelica Mt. in Serbia and its contemporary neighbors [2] and to determine emerging glass industry patterns in late antiquity Balkans and beyond [3].
MicroBeam-PIXE was utilized for research of size-dependent effects of gold nanoparticles uptake on maturation and antitumor functions of human dendritic cells [4] and recently for a failure analysis of total knee replacement with an uncemented porous tantalum tibia component [5]. NRA and RBS techniques are frequently exploited to determine material properties inside the tokamaks wall material for ITER project [6].

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P.S.100.

Composite scaffolds for regenerative dentistry applications

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Polymer composites have found wide application in the field of regeneration of bone tissue, dentine and pulp-like tissue, and in drug delivery to treat various oral and periodontal diseases. In this work, the processing and characterization of composite scaffolds based on gelatin (Gel) with β-tricalcium phosphate (β-TCP) were presented. The scaffolds were processed by the solution casting method. The gelatin was cross-linked with citric acid (CA) to improve the mechanical properties of the scaffold. The physicochemical characterization of scaffolds was investigated by FTIR spectroscopy which revealed cross-linking of the composite. The influence of β-TCP on the thermal properties of obtained scaffolds was investigated by DSC analysis. The tensile test and microindentation have indicated better mechanical properties of scaffolds cross-linked by CA. These results have shown that Gel-β-CA scaffolds have good potential for regenerative dentistry applications.

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P.S.101.

Exploring the potential of 4D bioprinting of smart PLGA-PEG-PLGA based hydrogel for personalized medicine

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The development of smart hydrogels for 4D bioprinting holds tremendous promise in the realms of tissue engineering, pharmaceutical production, and medical implant fabrication. This study focuses on utilizing a bioresorbable temperature-responsive hydrogel to create a scaffold capable of responding to external stimuli. The proposed hydrogel material, based on a synthetic biodegradable copolymer known as poly(lactic acid), poly(glycolic acid), and poly(ethylene glycol) (PLGA-PEG-PLGA),[1] enhanced with itaconic acid, offers unparalleled properties for 4D bioprinting. These hydrogels exhibit responsiveness to various physical and chemical stimuli, including blue light, temperature, pH changes, and multivalent ions, rendering them highly suitable for tissue regeneration applications. The combination of low-temperature 3D printing and the designed hydrogel material has the potential to employed avoiding damage to human dermal fibroblasts (HDF) cells and manufacture personalized implants and drug delivery systems.[2] The objectives of this research endeavor are threefold: to synthesize a stimuli-responsive hydrogel, enrich the hydrogel with HDF cells and to 4D bioprint it uses blue light crosslinking in the presence of a photoinitiator and pH changes. Subsequently, the printed hydrogel carriers' cyto-compatibility, stability, mechanical properties, strength, and stiffness under physiological conditions were evaluated. The PLGA-PEG-PLGA modified material was characterized using ^{1}H NMR spectroscopy and rheology, confirming its suitability for 3D printing. The optimization of the printing process involved fine-tuning parameters such as printing pressure, speed, and sample shape until homogenous and reproducible samples were achieved. The duration of blue light crosslinking was determined to be 20 seconds. Finally, the viability of human dermal fibroblast cells (HDF) was assessed using the Alamar blue assay, which revealed that cell growth remains unaffected in the presence of the hydrogel.

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P.S.102.

Dielectrophoretic manipulation of MXenes flakes

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Dielectrophoresis, as AC electrokinetic manipulation technique, has been widely employed within the literature for trapping or de-trapping various nano or micro target objects from biological cells (yeast, malignant or non-malignant) to particles as nanotubes, nanorods, nanowires, OLCs, nanoflakes. On the other hand, MXenes, as of their outstanding sensing properties and incommensurable functionalization possibilities, are among the 2D compounds which are expecting to play key functional active role in development of future miniaturized flexible sensors. Thus, particular consideration has to be allocated for developing robust integrative solutions for their integration at the level of various sensing devices. Consequently, within the herein work we are presenting a pioneering experimental study on successful electromanipulation of MXenes flakes via dielectrophoresis at the level of a set of screen-printed interdigitated electrodes patterned on top of a polyester based substrate. Importance of different dielectrophoretic parameters is discussed in respect to electric field gradient field and its frequency with brief emphasis on usefulness of correctly and optimally selecting the suspending medium in terms of electric conductivity as well as MXenes concentration.

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