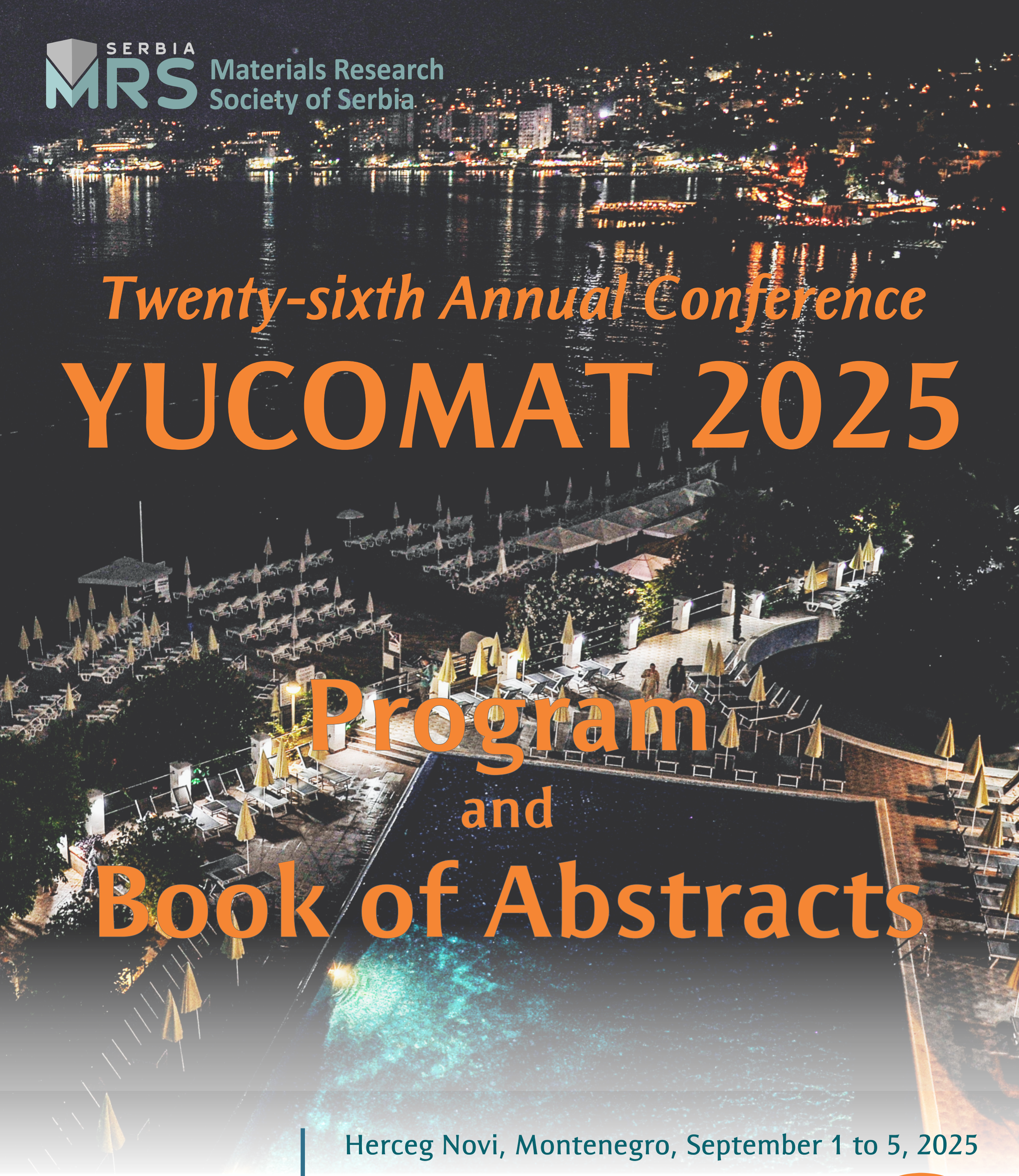
SERBIA MRS Materials Research Society of Serbia



Twenty-sixth Annual Conference

YUCOMAT 2025

Program
and
Book of Abstracts

Herceg Novi, Montenegro, September 1 to 5, 2025

endorsed by

FEMS
FEDERATION OF EUROPEAN MATERIALS SOCIETIES

SERBIA MRS Materials Research Society of Serbia
YUCOMAT 2025
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TWENTY-SIXTH ANNUAL CONFERENCE ON MATERIAL SCIENCE

YUCOMAT 2025

Hunguest Hotel Sun Resort, Herceg Novi, Montenegro
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Herceg Novi, Montenegro, September 1 to 5, 2024

Program and Book of Abstracts

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ABSTRACTS

WELCOME SPEECH BY THE PRESIDENT OF MRS-SERBIA

Esteemed Colleagues, Fellow Scientists and Honored Guests,

It is my great honor and pleasure to welcome you on behalf of the Materials Research Society of Serbia, at the very place where, thirty years ago, the Founding Conference of our Society was held.

The final quarter of the twentieth century was marked by tremendous achievements in the field of new materials and nanotechnology. During that time, departments, faculties, and societies began forming — first in the United States, and soon thereafter across the world. The first Materials Research Society (MRS) was established in the U.S. in 1973, followed by E-MRS in Strasbourg in 1983, and subsequently societies in Japan and India (1989), Mexico (1990) and Korea (1991). Around that time, under the most unusual circumstances imaginable, a small Materials Research Society (Yu-MRS) began to grow. Due to the political situation in the country, it soon transformed into MRS-Serbia. Isolated from the world and burdened by United Nations sanctions from June 1992 onward, about twenty leading researchers in various fields of materials science and engineering — from physics, physical chemistry, and chemistry, to ceramics, metals, polymers, fine particles, thin films, and monocrystals — began discussing the idea of forming such a society. Throughout 1995, they worked to bring colleagues together around this idea. In September 1995, we organized the conference "Challenges in New Materials" in Herceg Novi, a location chosen due to its earlier successful experience with sintering conferences and its long-standing congress tourism tradition. Around one hundred papers were presented — forty invited and seventy posters — all by domestic participants. Following the presentations and an engaging discussion, the consensus was that the time was ripe to form a Materials Research Society in our region. An initiative board was established to take on this task.

By the second YUCOMAT Conference in September 1997, the Society was fully registered and equipped with all necessary organizational elements. The third Conference, held in 1999, took place under extremely difficult conditions, right after the NATO bombing campaign had ended. Despite everything, around one hundred domestic scientists participated, along with a single international guest, Dr. Giovanni Battiston from CNRS Padova, who, upon arriving, simply said: "I gave my word, and here I am." He also provided financial assistance to help us print the Conference Proceedings with Trans Tech Publications in Zurich. From 2003 onward, the situation began to normalize. English became the official language of the Conference, which has been organized annually ever since. In 2005, we established the International Program Committee, which greatly aided the internationalization of the event. In 2008, we became a full member of FEMS, and the number of participants stabilized at 150–200, with a steady increase in the share of international contributors. Just before the COVID-19 pandemic in 2020, the ratio of international to domestic presentations reached 4:1.

One of our most significant initiatives began as early as 1999, namely the Young Researchers Competition, for researchers under the age of 35. Awards are given for the best doctoral thesis completed between two conferences, and for the best oral and poster presentations. The number of awardees has reached approximately 150, with a nearly equal share of domestic and international recipients. As the Conference gained a reputation for “international excellence,” in 2015 we established the Annual Society Award for Outstanding Contributions to Materials Science and Engineering. Initially awarded to scientists from the ex-Yugoslavia region, the award was later internationalized and can now be granted to any distinguished individual worldwide who has significantly contributed to the field of materials science and to the growth of the Society. So far, 11 prominent scientists have received this award: Ivan Božović (2015), Gordana Vunjak-Novaković (2016), Velimir Radmilović (2017), László Forró (2018), Danilo Suvorov (2019), Robert Sinclair (2020), Yury Gogotsi (2021), Richard Siegel (2022), Knut Urban (2023), Vladimir Torchilin (2024), Hamish Fraser (2025).

This year's awardee is Prof. Hamish Fraser from The Ohio State University, for his exceptional contribution in the areas of analytical electron microscopy, materials processing of advanced materials, and integrated computational materials science and engineering. Prof. Fraser has been a featured invited speaker at more than ten YUCOMAT Conferences, is a member of our International Advisory Board, and has significantly contributed to sponsor engagement for the event. According to one of the nominators, Prof. Knut Urban, Prof. Fraser has successfully bridged basic and applied research and created an outstanding Center for Electron Microscopy and Spectroscopy (CEMAS) at Ohio State University, producing excellent results in collaboration with university staff and students. Detailed information regarding Prof. Fraser's selection can be found in the YUCOMAT 2025 Program and Book of Abstracts. Following this ceremonial opening, he will deliver a lecture titled "The Role of Modern Physical Metallurgy in the Development of Alloys and Materials Processing."

At the initiative of our Korean and Taiwanese colleagues, members of the International Advisory Board, in 2018 we began organizing Satellite Symposia. Around fifteen professors and students participated in each. Together with our Taiwanese partners, we held the symposium "Advanced Materials for Biomedical Engineering", and with Busan University from Korea, "Advanced Hybrid and Composite Materials." At YUCOMAT 2017, we also organized a Satellite Symposium where about fifteen prominent scientists from the ex- Yugoslav diaspora presented their latest research, aiming to strengthen our ties with the global scientific community. This year, for the first time, we are organizing an Invited Oral Session. We have begun with a session featuring nine oral presentations, with the intention that, in future years, this becomes a platform for younger researchers who already have significant achievements. This would serve as a natural extension of the Young Researchers Awards for best oral presentations at YUCOMAT.

This year's Conference features 4 Plenary Sessions, 1 Invited Oral Session, 3 regular oral sessions, and 3 poster sessions. As in previous years, around 130 papers will be presented. All plenary speakers listed in the Program have confirmed their participation, and this year we have what many other conferences do not: an exceptionally large number of highly ranked speakers, based on global citation indices. At this year's YUCOMAT, 5 of the world's top 40 most cited scientists will speak, with all plenary lecturers having h-indices above 100 and over 100,000 citations. Over the last 5 years, 25 of the top 100 globally ranked researchers have spoken at YUCOMAT at least once—some of them multiple times—placing our Conference among the top-tier events in terms of plenary lecture quality, which is a key metric for evaluating scientific conferences.

In closing, I sincerely thank you for being here today to mark this important occasion and reflect on how far we have come and what lies ahead. I wish you a pleasant stay and hope you carry lasting memories from this Conference and from Herceg Novi.

Prof. Dr. Dragan Uskoković
President, MRS-Serbia

2025 MRS-SERBIA AWARD FOR A LASTING AND OUTSTANDING CONTRIBUTION TO MATERIALS SCIENCE AND ENGINEERING

We are pleased to announce that the Laureate of the 2025 MRS-Serbia Award for a Lasting and Outstanding Contribution to Materials Science and Engineering is

Prof. Dr. Hamish Fraser

For his exceptional contributions in the areas of analytical electron microscopy, materials processing of advanced materials, and integrated computational materials science and engineering.

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

The Executive Board of the MRS-Serbia Presidency at their online meeting held on March 6th, 2025, considered the submitted nomination for the MRS-Serbia's 2025 Award for a Lasting and Outstanding Contribution to Materials Science and Engineering and 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, 2024, and that in the stipulated period of 45 days only one nomination was submitted.

Having received the opinion from the Expert Committee members: Prof. Dr. Dragan Uskoković (President of MRS-Serbia), Prof. Dr. Yury Gogotsi (Chair of YUCOMAT Conferences International Advisory Board and 2021 Laureate), Prof. Dr. Robert Sinclair (Honorary Chair of YUCOMAT Conferences International Advisory Board and 2020 Laureate), Prof. Dr. Dejan Raković (Vice-President of MRS-Serbia), Prof. Dr. Slobodan Milonjić (President of the Council and Member of the Presidency of MRS-Serbia), Prof. Dr. Ivan Božović (2015 Laureate), Prof. Dr. Gordana Vunjak-Novaković (2016 Laureate), Prof. Dr. Velimir Radmilović (2017 Laureate), Prof. Dr. László Forró (2018 Laureate) Prof. Dr. Danilo Suvorov (2019 Laureate), Prof. Dr. Sinclair Robert (2020 Laureate), Prof. Dr. Yury Gogotsi (2021 Laureate), Prof. Dr. Richard W. Siegel (2022 Laureate), Prof. Dr. Knut Urban (2023 Laureate), and Prof. Dr. Vladimir Torchilin as a 2024 Laureate.

The Executive Board of the MRS-Serbia Presidency took the decision that Prof. Dr. Hamish Fraser should be granted MRS-Serbia's 2025 Award for a Lasting and Outstanding Contribution to Materials Science and Engineering.

Prof. Fraser was strongly supported by Prof. Dr. Dragan Uskoković, Dr. Slobodan Milonjić, Prof. Dr. Velimir Radmilović, Prof. Dr. Dejan Raković, Prof. Dr. Djordje Janaćković.

Prof. Fraser's Honorary Plenary Lecture will be delivered during the Opening Ceremony of the 26th MRS-Serbia Annual Conference YUCOMAT 2025, starting at 9:00 AM on Monday, September 1st, 2025.

President of MRS-Serbia, Prof. Dr. Dragan Uskoković
President of the Council Dr. Slobodan Milonjić
Vice-President of MRS-Serbia, Prof. Dr. Velimir Radmilović
Vice-President of MRS-Serbia, Prof. Dr. Dejan Raković

MATERIALS RESEARCH SOCIETY OF SERBIA

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.

YUCOMAT 2025 COMMITTEES

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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 YUCOMAT 2025 Conference will be held on September 1-5, 2025, at the Hunguest Hotel Sun Resort, in Herceg Novi, Montenegro. Participants will also be accommodated there. The conference will begin on Monday, September 1st, at 08^{30} and will conclude on Friday, September 5th, 2025, at 12^{00}.

REGISTRATION: Registration, registration fee payment, conference materials distribution, etc, will take place at the conference desk, which will be open on: Sunday to Tuesday from 8^{00} to 19^{00}, on Wednesday and Thursday from 8^{00}-12^{00} and 19^{00}-20^{00}, and on Friday from 8^{00} to 12^{00}. At registration, the participants are requested to submit proof of their advance registration fee payment to the Conference Secretariat.

INSTRUCTION FOR AUTHORS: The conference will feature Plenary Sessions, Invited Oral Sessions, Oral Sessions and Poster Sessions. Time available for delivery is 40 min for Plenary Session, 20 min for Invited Oral Sessions and 15 min for Oral Session papers, including discussion. Video-beam is available. PowerPoint presentations, recorded on 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. Poster sessions' venue will be open from Tuesday to Thursday.

CONFERENCE AWARDS: Award by MRS-Serbia at the YUCOMAT 2025 Conference to the authors not older than 35 for the best: Three Oral presentation and Three Posters presentation and best PhD completed between the two YUCOMAT conferences. Awarded authors will be announced at the Closing Ceremony of the Conference. Each award consists of diploma, meeting registration fee to attend the next YUCOMAT 2026 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 2025 CONFERENCE PROGRAM

Sunday, August 31, 2025

08^{00} - 19^{00}	**Registration**

Monday, September 1, 2025

08^{00} - 19^{00}	**Registration**
08^{30} - 09^{00}	**OPENING CEREMONY and Awards,** Main Conference Hall Welcome Speech -**Dragan Uskoković**, president of MRS-Serbia **Presentation of YUCOMAT & WRTCS 2024 Awards** for young authors of the best PhD thesis, oral and poster presentation
09^{00} - 09^{45}	MRS-Serbia 2025 Award for a Lasting and Outstanding Contribution to Materials Science and Engineering **Hamish L. Fraser**
10^{30} - 13^{10}	**First Plenary Session**, Main Conference Hall
13^{15}	**Photo Session**
15^{00} - 19^{00}	**Second Plenary Session**, Main Conference Hall
20^{00} - 22^{00}	**Cocktail Party**

Tuesday, September 2, 2025

08^{00} - 09^{45}	**First Poster Session,** National Restaurant Jadranka Terrace **Competition for the best poster presentation by young researchers**
10^{00} - 12^{40}	**Third Plenary Session,** Main Conference Hall
15^{00} - 18^{20}	**First Oral Session, Competition for the Best Oral Presentation,** Main Conference Hall

Wednesday, September 3, 2025

08^{00} - 09^{45}	**Second Poster Session**, National Restaurant Jadranka Terrace
10^{00} - 12^{20}	**Invited Oral Session**, Main Conference Hall
15^{00} - 18^{00}	**Second Oral Session,** Main Conference Hall

Thursday, September 4, 2025

08^{00} - 09^{45}	**Third Poster Session**, National Restaurant Jadranka Terrace
10^{00} - 12^{40}	**Fourth Plenary Session,** Main Conference Hall
14^{00}	**Boat-trip around Boka Kotorska Bay**

Friday, September 5, 2025

09^{00} - 11^{30}	**Third Oral Session**, Main Conference Hall
11^{30}	**Closing Ceremony - YUCOMAT 2025 Award Grants for Young Researchers**
12^{00}	**Farewell cocktail**

SCIENTIFIC PROGRAM

Sunday, August 31, 2025

08^{00} - 19^{00} Registration

Monday, September 1, 2025

OPENING CEREMONY, Main Conference Hall

08^{30} - 09^{00} Welcome Speech **- Dragan Uskoković**, president of MRS-Serbia,
Presentation of YUCOMAT & WRTCS 2024 Awards for young authors with the best PhD thesis, oral and poster presentations

09^{00} - 09^{45} **MRS-Serbia 2025 Award for a Lasting and Outstanding Contribution to Materials Science and Engineering**
Hamish L. Fraser
Materials Science and Engineering, The Ohio State University, USA
The role of modern physical metallurgy in alloy development and materials processing

09^{45} - 10^{30} **Break**

FIRST PLENARY SESSION, Main Conference Hall

Session I: 10^{30} -13^{10}
Chairpersons: Pulickel Ajayan, Andrea C. Ferrari

10^{30} - 11^{10} **PL.S.1.**
New methods to grow diamond and cubic boron nitride
Rodney Ruoff
Center for Multidimensional Carbon Materials, Institute for Basic Science, Republic of Korea and Department of Chemistry, Ulsan National Institute of Science and Technology, Republic of Korea

11^{10} - 11^{50} **PL.S.2.**
Graphene and layered materials for photonics, optoelectronics and quantum technologies
Andrea C. Ferrari
Cambridge Graphene Centre, University of Cambridge, Cambridge, UK

11^{50} - 12^{30} **PL.S.3.**
2D and 3D phases of boron-carbon-nitrogen
Pulickel M. Ajayan
Department of Materials Science and Nano Engineering, Rice University, Houston, Texas, USA

12^{30} - 13^{10} **PL.S.4.**
Synthesis and properties of novel carbon nanodots
Maurizio Prato
Center for Cooperative Research in Biomaterials, CIC BiomaGUNE, San Sebastián, Spain and Department of Chemical and Pharmaceutical Sciences, University of Trieste, Italy

13^{15} **Photo session**

13^{30}-15^{00} **Break**

SECOND PLENARY SESSION Main Conference Hall

Session II: 15^{00}-19^{00}
Chairpersons: Kostya Novoselov, Yu Huang, Mercouri Kanatzidis

15^{00} - 15^{40} **PL.S.5.**
Materials for the future
Kostya S. Novoselov
Institute for Functional Intelligent Materials, National University of Singapore, Singapore

15^{40} - 16^{20} **PL.S.6.**
Colloidal metal nanocrystals: moving from academic studies to industrial applications
Younan Xia
The Wallace H. Coulter Department of Biomedical Engineering, School of Chemistry and Biochemistry, and School of Chemical and Biomolecular Engineering, Georgia Institute of Technology, Atlanta, Georgia, USA

16^{20} - 17^{00} **PL.S.7.**
Phase engineering of nanomaterials (PEN)
Hua Zhang
Department of Chemistry, Hong Kong Institute for Clean Energy, City University of Hong Kong, Hong Kong, China

17^{00} - 17^{40} **PL.S.8.**
Halide perovskites: pioneering materials for clean energy and advanced technologies
Mercouri G. Kanatzidis
Department of Chemistry, Northwestern University, Evanston, IL, USA

17^{40} - 18^{20} **PL.S.9.**
Accelerating catalyst design for sustainable energy future
Yu Huang
University of California Los Angeles, Los Angeles, CA, USA

18^{20} - 19^{00} **PL.S.10.**
Supramolecular plastics for a sustainable future
Takuzo Aida
Department of Chemistry and Biotechnology, The University of Tokyo and Center for Emergent Matter Science, Hirosawa, Wako, Japan

20^{00} **Cocktail Party**

Tuesday, September 2, 2025

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

Session I: 08^{00} - 09^{45}
Chairpersons: Sonja Jovanović, Đorđe Veljović

SYMPOSIUM A: ADVANCED METHODS IN SYNTHESIS AND PROCESSING OF MATERIALS

P.S.1.

(4-Anisole)triphenyltin(IV) as a potential bioactive agent: synthesis, characterisation and BSA interaction analysis

Slađana Kovačević[1], Sascha C. Schneeweiß[1], Žiko Milanović[2], Zorica Leka[3], Goran N. Kaluđerović[1]

[1]University of Applied Sciences, Department of Engineering and Natural Sciences, Merseburg, Germany, [2]University of Kragujevac-Institute for Information Technologies Kragujevac, Kragujevac, Serbia, [3]University of Montenegro, Faculty of Metallurgy and Technology, Podgorica, Montenegro

SYMPOSIUM B: ADVANCED MATERIALS FOR HIGH-TECHNOLOGY APPLICATION

P.S.2.

PLD-grown thin films of STO on silicon photocathodes for photoelctrochemical hydrogen evolution reaction

Darija Petković[1], Hsin-Chia Ho[2], Janez Kovač[3], Urška Trstenjak[2], Damjan Vengust[2], Sonja Jovanović[1], Matjaž Spreitzer[2], Zoran Jovanović[1]

[1]Laboratory of Physics, Vinča Institute of Nuclear Sciences, University of Belgrade, Belgrade, Serbia, [2]Advanced Materials Department, Jožef Stefan Institute, Ljubljana, Slovenia, [3]Department of surface Enfineering, Jožef Stefan Institute, Ljubljana, Slovenia

P.S.3.

Tuning of persitent luminescence and thermoluminescence performance of $LiGa_5O_8:Cr^{3+}$ spinel modified by addition of aluminum and indium

Anastasiia Karabut[1], Halyna Zhydachevska[1], Vasyl Hreb[2], Leonid Vasylechko[2], Yaroslav Zhydachevskyy[1], Andrzej Suchocki[1]

[1]Institute of Physics, Polish Academy of Sciences, Warsaw, Poland, [2]Lviv Polytechnic National University, Lviv, Ukraine

P.S.4.

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Tamara Petrović[1], Miloš Milović[2], Danica Bajuk-Bogdanović[1], Jana Mišurović[3], Dominic Bresser[4,5,6], Milica J. Vujković[1,7]

[1]University of Belgrade, Faculty of Physical Chemistry, Belgrade, Serbia, [2]Department of Theoretical Physics and Condensed Matter Physics, Vinča Institute of Nuclear Sciences, University of Belgrade, Belgrade, Serbia, [3]University of Montenegro, Faculty of Metallurgy and Technology, Podgorica, Montenegro, [4]Institute Ulm, Ulm, Germany, [5]Karlsruhe Institute of Technology, Karlsruhe, Germany, [6]Ulm University, Ulm, Germany, [7]The Centre for Interdisciplinary and Multidisciplinary Studies, University of Montenegro, Podgorica, Montenegro

SYMPOSIUM C: **NANOSTRUCTURED MATERIALS**

P.S.5.

GO-based nanocomposites with WPA and PTCDA for application in electrochemical supercapacitors

Milica Pejčić[1], Željko Mravik[1], Danica Bajuk-Bogdanović[2], Marija Milićević[1], Ana Mraković[1], Vladimir Rajić[1], Janez Kovač[3], Zoran Jovanović[1]

[1]Laboratory of Physics, Vinča Institute of Nuclear Sciences, University of Belgrade, Belgrade, Serbia, [2]Faculty of Physical Chemistry, University of Belgrade, Belgrade, Serbia, [3]Department of Surface Engineering and Optoelectronics, Jožef Stefan Institute, Ljubljana, Slovenia

P.S.6.

A novel Co/Zn-ferrite molecularly imprinted polymer sensor for electrochemical detection of gallic acid

Marija Milićević[1], Seyda Yayla[2,3], Ahmet Cetinkaya[4], M. Mesud Hurkul[2], Zoran Jovanović[1], Sibel A. Ozkan[3], Sonja Jovanović[1]

[1]Laboratory of Physics, Vinca Institute of Nuclear Sciences, University of Belgrade, Serbia, [2]Department of Pharmaceutical Botany, Faculty of Pharmacy, Ankara University, Turkey, [3]Graduate School of Health Sciences, Faculty of Pharmacy, Ankara University, Turkey, [4]Department of Analytical Chemistry, Faculty of Pharmacy, Ankara University, Turkey

P.S.7.

Electrochemically obtained tungsten oxide electrodes doped *in-situ* with chromium and manganese for photoelectrochemical applications

Krzysztof Cichoń, Karolina Syrek

Faculty of Chemistry, Department of Physical Chemistry and Electrochemistry, Jagiellonian University, Kraków, Poland

P.S.8.

Adsorption of quercetin onto the two different types of nanomaterials that can be used as drug delivery materials

Ivan Bracanović, Aleksandar Krstić, Miloš Simić, Miljana Mirković, Ana Kalijadis

Vinča Institute of Nuclear Sciences, University of Belgrade, Belgrade, Serbia

P.S.9.

Green synthesis of polyphenol-derived nanoparticles from the branches of *Picea omorika* (Pančić) Purkyně and potential biomedical applications

Miljan Barić[1], Nevena Preradović[1], Jasna Simonović Radosavljević[1], Ksenija Radotić[1], Ana Popović Bijelić[2], Dragica Spasojević[1]

[1]University of Belgrade, Institute for Multidisciplinary Research, Serbia, [2]University of Belgrade, Faculty of Physical Chemistry, Serbia

P.S.10.

Improved electrochemical properties of niobium MXenes via addition of lanthanum for application in supercapacitors

Meriene Gandara[1], Tamara G Petrović[2], Milica Vujković[2], Lazar Rakocević[3], Emerson Sarmento Gonçalves[1,4], Elizabete Yoshie Kawachi[1], Biljana Šljukić[2,5]

[1]Instituto Tecnológico de Aeronáutica, Praça Marechal Eduardo Gomes, São José dos Campos, Brazil, [2]University of Belgrade, Faculty of Physical Chemistry, Belgrade, Serbia, [3]Vinča Institute of Nuclear Sciences, Department of Atomic Physics, Belgrade, Serbia, [4]Institute of Aeronautics and Space, Divisão de Materiais, São José dos Campos, Brazil, [5]Center of Physics and Engineering of Advanced Materials, Laboratory for Physics of Materials and Emerging Technologies, Chemical Engineering Department, Instituto Superior Técnico, Universidade de Lisboa, Lisbon, Portugal

P.S.11.

Hybrid polyaniline/rGO/AgNWs composites for high-performance EMI shielding

Brankica Gajić[1], Warda Saeed[2], Muhammad Yasir[2], Marija Radoičić[1], Jelena Potočnik[1], Danica Bajuk Bogdanović[3], Svetlana Jovanović[1]

[1]Vinča Institute of Nuclear Sciences – National Institute of the Republic of Serbia, University of Belgrade, Serbia, [2]Department of Computer Science, Division of Microrobotics and Control Engineering, University of Oldenburg, Germany, [3]Faculty of Physical Chemistry, University of Belgrade, Serbia

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

P.S.12.

Eu-Y and Eu-13X zeolites as novel materials for Norfloxacin removal from wastewater

Katarina Rondović[1], Marko Dević[2], Srna Stojanović[1], Vladislav Rac[3], Rastko Vasilić[2], Nenad Tadić[2], Ljiljana Damjanović-Vasilić[1]

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SYMPOSIUM E: **BIOMATERIALS**

P.S.13.

Mechanical and biological characterization of bone-like scaffolds with low and high alginate and calcium phosphate filler contents

Ivana Banićević[1], Mia Milošević[1,2], Jelena Petrović[1,2], Milena Milivojević[3], Michael Gasik[4], Jasmina Stojkovska[1], Bojana Obradović[1]

[1]University of Belgrade, Faculty of Technology and Metallurgy, Belgrade, Serbia, [2]Innovation Center of the Faculty of Technology and Metallurgy, Belgrade, Serbia, [3]University of Belgrade, Institute of Molecular Genetics and Genetic Engineering, Belgrade, Serbia, [4]AALTO University Foundation, Espoo, Finland

P.S.14.

Advancing osteosarcoma research: evaluation of a 3D osteosarcoma model for anticancer drug screening

Marija Pavlović[1], Ivana Banićević[1], Milena Milivojević[2], Radmila Janković[3], Jasmina Stojkovska[1], Bojana Obradović[1]

[1]University of Belgrade, Faculty of Technology and Metallurgy, Belgrade, Serbia, [2]University of Belgrade, Institute of Molecular Genetics and Genetic Engineering, Belgrade, Serbia, [3]University of Belgrade, Faculty of Medicine, Belgrade, Serbia

P.S.15.

Controlled release of ADSC-derived EVs from 3D-Printed PMMA-gelatin scaffolds for bone regeneration

Marija Milivojević[1], Teodora Jakovljević[1], Tamara Matić[2], Vukašin Ugrinović[1], Đorđe Janaćković[2], Maja Kosanović[3], Đorđe Veljović[2]

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P.S.16.

Impact of antimicrobial composite coatings on the performance of 3d-printed macroporous scaffolds for bone tissue engineering

Teodora Jakovljević[1], Olivera Dekanić[2], Tamara Matić[2], Vukašin Ugrinović[1], Tamara Vlajić[3], Milena Radunović[3], Đorđe Veljović[2]
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P.S.17.

Microscale tattooing of hydrogels and cells: benzoxaborole-driven microcontact printing of glycosylated surfaces

Mariusz Uchman[1], Nazim Pallab[2,3], Eric Sperlich[2], Matthias Schenderlein[3], Anne Krüger-Genge[3], Jinyuan Li[4], Lukas Zeininger[4], Zdenek Tošner[1], Martin Reifarth[2,3]
[1]Department of Physical and Macromolecular Chemistry, Faculty of Science, Charles University, Prague, Czech Republic, [2]Institute of Chemistry, University of Potsdam, Potsdam, Germany, [3]Fraunhofer Institute of Applied Polymer research, Potsdam, Germany, [4]Responsive Soft Materials and Interfaces Lab, Department of Colloid Chemistry, Max Planck Institute of Colloids and Interfaces, Potsdam, Germany

09^{45}-10^{00} Break

THIRD PLENARY SESSION Main Conference Hall

Session III: 10^{00} - 12^{40}
Chairpersons: Vladimir P. Torchilin, Joseph T. Hupp

10^{00} - 10^{40} **PL.S.11.**

Novel materials for nanosized drug delivery systems

Vladimir Torchilin
Department of Pharmaceutical Sciences and Center for Pharmaceutical Biotechnology and Nanomedicine, Northeastern University, Boston, USA

10^{40} - 11^{20} **PL.S.12.**

Designing, constructing, and uniformly accessing arrays of clusters of atomically precise composition for heterogeneous catalysis of chemical reactions

Joseph T. Hupp
Department of Chemistry, Northwestern University, Evanston, IL, U.S.A.

11^{20} - 12^{00} **PL.S.13.**

Repairing and upcycling of electrode materials from spent Li ion batteries

Hui-Ming Cheng
Shenyang National Laboratory for Materials Science, Institute of Metal Research CAS and Institute of Technology for Carbon Neutrality, Shenzhen Institute of Advanced Technology, CAS, China

12^{00} - 12^{40} **PL.S.14.**

Stress-dissipation strategy stabilized solid oxide cathodes for high-performance allsolid-state lithium batteries

Chunxi Lin, Xiuli Wang, Jiangping Tu
State Key Laboratory of Silicon and Advanced, Semiconductor Materials, School of Materials Science& Engineering, Zhejiang University, China

12^{40} - 15^{00} Break

FIRST ORAL SESSION, Competition for the best oral presentation by young researchers, Main Conference Hall

Session IV: 15^{00}-18^{20}
Chairpersons: Vuk Radmilović, Marija Drndić

15^{00} - 15^{20} I.O.S.1

Advancements in thin film oxides: exploring interface functionalities
Nini Pryds
Department of Energy Conversion and Storage, Technical University of Denmark, Denmark

SYMPOSIUM A: ADVANCED METHODS IN SYNTHESIS AND PROCESSING OF MATERIALS

15^{20} - 15^{35} O.S.I.1.

The influence of yellowing of the recycled plastic surfaces on their dyeing
Benita Malinowska [1,2], Michał Chodkowski[3], Konrad Terpiłowski[2]
[1]Polska Korporacja Recyklingu sp. z o.o., Lublin, Poland, [2]Maria Curie-Sklodowska University, Department of Interfacial Phenomena, Lublin, Poland,[3] Lublin University of Technology, Department of Technology and Polymer Processing, Poland

15^{35} - 15^{50} O.S.I.2.

Analysis of microstructure and mechanisms of plastic deformation of high-strength Mg-Zn-Y alloys
Zsolt Beke[1], Andrea Farkas[1], Patrik Dobroň[1], Soya Nishimoto[2], Shinichi Inoue[3], Michiaki Yamasaki[2], Yoshihito Kawamura[3], Gergely Németh[4], Kristián Máthis[1], Daria Drozdenko[1]
[1]Charles University, Department of Physics of Materials, Prague, Czech Republic, [2]Kumamoto University, Graduate School of Science and Technology, Kumamoto, Japan, [3]Magnesium Research Center, Kumamoto University, Kumamoto, Japan, [4]Nuclear Physics Institute of the Czech Academy of Science, Czech Republic

15^{50} - 16^{05} O.S.I.3.

Ablative-oxidative LIPSS generation on Si: theory and applications
Iaroslav Gnilitskyi
Department of Applied Physics and Nanomaterials Science, Lviv Polytechnic National University, Lviv, Ukraine and NoviNano Lab LLC, Lviv, Ukraine

SYMPOSIUM B: ADVANCED MATERIALS FOR HIGH-TECHNOLOGY APPLICATION

16^{05} - 16^{20} O.S.I.4.

Defect engineering and opening of the ion tracks in the swift heavy ion irradiated thin films of bismuth vanadate: Impact on oxygen evolution reaction for solar water splitting
Marko Jelić[1], Zoran Jovanović[1], Ekaterina Korneeva[2], Nina Daneu[3], Suraj Gupta[3], Jacques O'Connell[4], Tatiana Vershinina[2,5], Nikita Kirilkin[2,] Ivana Stojković Simatović[6,] Vladimir Skuratov[2,5,7], Sonja Jovanović[1]
[1]Vinča Institute of Nuclear Sciences, University of Belgrade, Belgrade, Serbia, [2]Joint Institute for Nuclear Research, Dubna, Russia, [3]Jožef Stefan Institute, Ljubljana, Slovenia, [4]Nelson Mandela University, Port Elizabeth, South Africa, [5]National Research Nuclear University MEPhI, Moscow, Russia, [6]University of Belgrade, Faculty of Physical Chemistry, Belgrade, Serbia, [7]Dubna State University, Dubna, Russia

SYMPOSIUM C: **NANOSTRUCTURED MATERIALS**

16^{20} - 16^{35} **O.S.I.5.**

Highly efficient hydrogen evolution using ultra-low platinum loading in CaO-based electrocatalysts

Klaudia Zielinkiewicz[1,2], Ewa Mijowska[1,2]
[1]Department of Nanomaterials Physicochemistry, Faculty of Chemical Technology and Engineering, West Pomeranian University of Technology, Szczecin, Poland, [2]Centre for Advanced Materials and Manufacturing Process Engineering (CAMMPE), West Pomeranian University of Technology, Poland

16^{35} - 16^{50} **O.S.I.6.**

Nearly percolated silver films for tailoring infrared losses: a morphology-based approach

Hrishikesh Kamble, Vesna Janicki, Jordi Sancho-Parramon
Ruđer Bošković Institute, Zagreb, Croatia

16^{50} - 17^{05} **O.S.I.7.**

PDMS-based magnetic nanocomposites: effect of magnetic nanoparticles on viscosity and wettability

Ibtissame Sidane[1], Simone Pettineo[1], Maila Castellano[1], Davide Peddis[1,2] Stefano Alberti[1], Sawssen Slimani[1,2]
[1]Department of Chemistry and Industrial Chemistry, University of Genova, Genova, Italy, [2] Institute of Structure of Matter, National Research Council, Roma, Italy

17^{05} - 17^{20} **O.S.I.8.**

Correlative spectromicroscopy of platinum-based catalysts on 2D materials: from fabrication to catalytic activity

Iryna Danylo[1], Martina Pitínová[1,] Tomáš Hartman[2], Martin Veselý[1]
[1]Department of Organic Technology, University of Chemistry and Technology, Prague, Czechia,[2]Department of Inorganic Chemistry, University of Chemistry and Technology, Prague, Czechia

17^{20} - 17^{35} **O.S.I.9.**

Application of Ion Beam Irradiation for Engineering of Graphene Oxide-Based Environmental Sensors

Željko Mravik[1,2], Milica Pejčić[1], Marija Milićević[1], Predrag Stolić[3], Sonja Jovanović[1], Zoltán Száraz[4], Filip Ferenčík[4], Pavol Noga[4], Zoran Jovanović[1,2]
[1]Laboratory of Physics, Vinča Institute of Nuclear Sciences, University of Belgrade, Belgrade, Serbia, [2]Center of Excellence for Hydrogen and Renewable Energy , Vinča Institute of Nuclear Sciences, University of Belgrade, Belgrade, Serbia, [3]Technical faculty in Bor, University of Belgrade, Bor, Serbia, [4]Slovak University of Technology in Bratislava, Faculty of Materials Science and Technology in Trnava, Advanced Technologies Research Institute, Trnava, Slovakia

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

17^{35} - 17^{50} **O.S.I.10.**

Effect of Hydrogen Uptake on the Structural and Mechanical Performance of Ti-6Al-4V and Ti-0.3Mo-0.8Ni Alloys

Marcin Wiśniewski[1,2], Daria Drozdenko[1], Patrik Dobroň[1][1]*Charles University, Faculty of Mathematics and Physics, Department of Physics of Materials, Prague, Czech Republic, [2]Wrocław University of Science and Technology, Faculty of Mechanical Engineering, Department of Vehicle Engineering, Wrocław, Poland*

SYMPOSIUM E: **BIOMATERIALS**

17^{50} - 18^{05} O.S.I.11.

Advancing protein-based biomaterials for enhanced wound healing and angiogenesis

Dávid Izsák[1], Veronika Pavliňáková[1], Sahar Dinparvar[1], Petra Kolísková[2], Marcela Buchtová[2], Lucy Vojtová[1]

[1]CEITEC BUT, Central European Institute of Technology, Advanced biomaterials, Brno University of Technology, Brno, Czech Republic, [2]Institute of Animal Physiology and Genetics, The Czech Academie of Science, Brno, Czech Republic

18^{05} - 18^{20} O.S.I.12.

Surface effect in spinel Iron Oxide Hollow Nanoparticles

Sawssen Slimani[1,2], Marianna Vasilakaki[3], Kalliopi N Trohidou[3], Nader Yaacoub[4], Davide Peddis[1,2]

[1]Department of Chemistry and Industrial Chemistry & Genova, INSTM RU, nM2-Lab, University of Genova, 16146 Genova, Italy, [2]Institute of Structure of Matter, National Research Council, nM2-Lab, Via Salaria km 29.300, Monterotondo Scalo 00015, Roma, Italy, [3]Institute of Nanoscience and Nanotechnology, NCSR "Demokritos", 15310 Agia Paraskevi, Attiki, Greece, [4]Le Mans Université, IMMM, CNRS UMR-6283, Avenue O. Messiaen, Le Mans, 72085, France

Wednesday, September 3, 2025

Second Poster Session, National Restaurant Jadranka Terrace

Session II: 08^{00} - 09^{45}
Chairperson: Veljko Đokić, Zoran Jovanović

SYMPOSIUM A:
ADVANCED METHODS IN SYNTHESIS AND PROCESSING OF MATERIALS

P.S.18.

Synthesis of magnetic sorbents for removal of zinc ions using iron-containing wastewater

Gennadii Kochetov, Dmytro Samchenko, Oles Lastivka

Kyiv National University of Construction and Architecture, Ukraine

P.S.19.

Change in the properties of 3D printed samples as a function of filament density

Mária Mihaliková[1], Elena Čižmárová[2]

[1]Technical University of Košice, Faculty of Materials, Metallurgy and Recycling, Institute of Materials, Košice, Slovakia, [2]Innovation Centre for Diagnostics and Application of Materials, Faculty of Mechanical Engineering, Department of Materials Engineering, Praha, Czech republic

P.S.20.

Zn-Y zeolite photocatalytic oxide coatings on magnesium

Marko Dević[1], Nenad Tadić[1], Rastko Vasilić[1], Ljiljana Damjanović-Vasilić[2], Srna Stojanović[2], Katarina Rondović[2]

[1]University of Belgrade, Faculty of Physics, Belgrade, Serbia, [2]University of Belgrade, Faculty of Physical Chemistry, Belgrade, Serbia

P.S.21.

Formation of functional coatings on selective laser melting Ti6Al4V by gas nitriding

Khrystyna Shliakhetka[1,2], Petra Krajnakova[1,2], Martin Balog[1,2], Francisca M. Seabra[1,2,3], Peter Krizik[1]
[1]Institute of Materials and Machine Mechanics, Slovak Academy of Sciences, Bratislava, Slovakia, [2]Centre for Advanced Materials Application, Slovak Academy of Sciences, Bratislava, Slovakia, [3]Faculty of Materials Science and Technology in Trnava, Slovak University of Technology, Trnava, Slovakia

P.S.22.

Zinc and manganese modified montmorillonite for anticorrosion applications in protective coatings on aluminium alloy

Sergiy Korniy, Mariia-Olena Danyliak
Karpenko Physico-Mechanical Institute of the National Academy of Sciences of Ukraine, Lviv, Ukraine

P.S.23.

Enhanced oxygen vacancy formation in Pt-WO_3 via W-OH bond cleavage using water-based one-step electrospinning for high-performance gas sensors

Liping Zhu, Denghui Huang
State Key Laboratory of Silicon and Advanced Semiconductor Materials, School of Materials Science and Engineering, Zhejiang University, Hangzhou, China

SYMPOSIUM B: **ADVANCED MATERIALS FOR HIGH-TECHNOLOGY APPLICATION**

P.S.24.

Enhancing hydrogen evolution: the role of rapid thermal treatment in modifying MAX structure

Milica Vujković[1,2], Nemanja Latas[3,4], Mirjana Novaković[5], Maja Popović[5], Dragana Jugović[6], Robert Dominko[3,4]
[1]University of Belgrade, Faculty of Physical Chemistry, Belgrade, Serbia, [2]Center for Interdisciplinary and Multidisciplinary Studies, University of Montenegro, Podgorica, [3]National Institute of Chemistry, Ljubljana, Slovenia, [4]FKKT, University of Ljubljana, Ljubljana, Slovenia, [5]Vinča Institute of Nuclear Sciences, University of Belgrade, Serbia, [6]Institute of Technical Sciences of SASA, Belgrade, Serbia

P.S.25.

Molten salt-assisted synthesis of MXenes: optimizing the MAX phase conversion

Jana Mišurović[1], Milica Vujković[2,3]
[1]University of Montenegro, Faculty of Metallurgy and Technology, Podgorica, Montenegro, [2]University of Belgrade, Faculty of Physical Chemistry, Belgrade, Serbia, [3]Center for Interdisciplinary and Multidisciplinary Studies, University of Montenegro, Podgorica, Montenegro

P.S.26.

Development of copper–silver core–shell pastes for heterojunction silicon solar cells

Behiye Demirtas[1], Huseyin Utkucan Kayaci[2, 3], Seda Kılıckaya Unver[4], Doga Doganay[1,3], Sahin Coskun[3,6], Simge Cinar Aygun[1], Bulent Arikan[4], Rasit Turan[4,5], Husnu Emrah Unalan[1,3]
[1]Department of Metallurgical and Materials Engineering, Middle East Technical University, Ankara, Türkiye, [2]Department of Micro and Nanotechnology, Middle East Technical University Ankara, Türkiye, [3]Nanovatif Materials Technologies, METU-TEKNOKENT, Ankara, Türkiye, [4]Center for Solar Energy Research and Applications, Middle East Technical University, Ankara, Türkiye, [5]Department of Physics, Middle East Technical University, Ankara, Türkiye, [6]Department of Metallurgical and Materials Engineering, Eskisehir Osmangazi University, Eskisehir, Türkiye

P.S.27.

Atomic-level insights into Cr^{3+} doped $Cs_2Na/AgInCl_6$ perovskites: ssNMR probes of paramagnetic species distribution and pseudo Jahn-Teller effect

Libor Kobera
Department of NMR spectroscopy, Institute of Macromolecular Chemistry, Czech Academy of Sciences, Czech Republic

P.S.28.

Integrated surface engineering strategies to improvement of corrosion and wear in highly porous titanium

Khrystyna Shliakhetka[1,2,3], Martin Balog[1,2], Serhii Lavrys[3,4], Iryna Pohrelyk[3], Petra Krajnakova[1,2]
[1]*Institute of Materials and Machine Mechanics, Slovak Academy of Sciences, Bratislava, Slovakia,* [2]*Centre for Advanced Materials Application Slovak Academy of Sciences, Bratislava, Slovakia,* [3] *Karpenko Physico-Mechanical Institute of the NAS of Ukraine, Lviv, Ukraine,* [4]*Vytautas Magnus University, Kaunas, Lithuania*

P.S.29.

Influence of precursor stoichiometry and mechanosynthesis modes on the hybrid organo-inorganic metal halide perovskite powders stability

Iryna Galstian
Leibniz Institute for Solid State and Materials Research, Dresden, Germany

P.S.30.

Indirect excitation of rare-earth ions through their surroundings

Petr Kostka[1,2], Roman Yatskiv[3], Jiri Zavadil[1], Olga Prochazkova[1], Petr Knotek[4]
[1]*Institute of Rock Structure and Mechanics, Czech Academy of Sciences, Prague,* [2]*University of Chemistry and Technology Prague,* [3]*Institute of Photonics and Electronics, Czech Academy of Sciences, Prague,* [4]*University of Pardubice, Pardubice, Czech Republic*

P.S.31.

Effects of strong electron correlations and nanoclusters formation in positron spectroscopy of disordered alloys: theoretical model

Tetiana Shatnii[1], Yevhen Tsapko[1], Tetiana Len[2], Iryna Galstian[1,3], Evgen Len[1,4]
[1]G.V. Kurdyumov Institute for Metal Physics, NAS of Ukraine, *Kyiv, Ukraine,* [2]*National Aviation University, Ukraine,* [3]*Leibniz Institute for Solid State and Materials Research, Dresden, Germany,* [4]*Kyiv Academic University, NAS and MES of Ukraine, Kyiv, Ukraine*

P.S.32.

Blocking oxygen vacancy migration in ZnO for stable perovskite solar cells: a DFT study

Evgen Len[1,2], Olga Kazakova[1,3], Mykhailo Varvarin[1,2], Mykhailo Rud[1], Iryna Galstian[1,4]
[1]*G.V. Kurdyumov Institute for Metal Physics, NAS of Ukraine, Kyiv, Ukraine,* [2]*Kyiv Academic University, NAS and MES of Ukraine, Kyiv, Ukraine,* [3]*Chuiko Institute of Surface Chemistry, NAS of Ukraine, Kyiv, Ukraine,* [4]*Leibniz Institute for Solid State and Materials, Dresden, Germany*

P.S.33.

Crystal structure design of new mixed $(Ga_{1-x-y}Al_xIn_y)_2O_3$ oxides

Leonid Vasylechko[1], Vasyl Hreb[1], Vitalii Stadnik[1], Yurii Hirskyi[1], Svitlana Turchak[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.34.

Influence of pre-deformation on mechanical properties and microstructure of en-aw 7075 aluminium alloy

Avram Kovačević, Uroš Stamenković, Milan Nedeljković
Technical faculty Bor, University of Belgrade, Serbia

P.S.35.

Modelling for H^{2+} ions in Ar/H_2 mixtures

Željka Nikitović, Zoran Raspopović
Institute of Physics University of Belgrade, Belgrade, Serbia

P.S.36.

Possible smart materials based on compounds with valence unstable rare earth elements

Ivan Shcherba[1], Markiian Kachmar[1], Henrik Noga[2], Lev Bekenov[3], Dragan Uskoković[4], Bohdan Jatsyk[5]
Faculty of Physics, Ivan Franko National University of Lviv, Ukraine, [2]Institute of Technical Sciences, University of the NEC, Krakow, Poland, [3]G. V. Kurdyumov Institute for Metal Physics of the N.A.S.U., Kyiv, Ukraine, [4]Institute of Technical Sciences of SASA, Belgrade, Serbia, [5]Lviv National University of Veterinary Medicine and Biotechnologies, Ukraine

P.S.37.

Glycine-nitrate synthesis and doping effects on NFPP for aqueous sodium-ion batteries

Aleksandra Gezović Miljanić[1], Veselinka Grudić[1], Robert Dominko[2], Milica Vujković[3]
[1]University of Montenegro, Faculty of Metallurgy and Technology, Podgorica, Montenegro, [2]National Institute of Chemistry, Ljubljana, Slovenia, [3]University of Belgrade, Faculty of Physical Chemistry, Belgrade, Serbia

P.S.38.

All-optical THz modulator based on MXene reflective structure

A. Andrushchak[1], Ya. Shchur[2], A. Danylov[1], O. Chuma[1], P. Solomenchuk[1], Ia. Gnilitskyi[1], O. Buryy[1]
[1]Lviv Polytechnic National University, Lviv, Ukraine, [2]Institute for Condensed Matter Physics, Lviv, Ukraine

P.S.39.

Co-based soft magnetic amorphous wires for matching the wide bandgap-based devices

Jelena M. Orelj[1], Radoslav S. Surla[1], Vladimir. B. Pavlović[2], Borivoje M. Nedeljković[1], Nebojša S. Mitrović[1]
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P.S.40.

Adenine to power: nitrogen-doped carbon nanofibers unlocking next-generation aqueous supercapacitors

Daniel M. Mijailović[1], Alen Vizintin[2], Elena Tchernychova[2], Vuk V. Radmilović[1], Mila N. Krstajić Pajić[1], Dušica B. Stojanović[1], Velimir R. Radmilović[1,3], Petar S. Uskoković[1]
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SYMPOSIUM C: **NANOSTRUCTURED MATERIALS**

P.S.41.

Expanding the MAX šhase: discovery of a double A-layer Ti_2Bi_2C MAX phase

Maxim Sokol, Yiftach Kushnir
Tel Aviv University, Israel

P.S.42.

Development of an electrically conductive coating for current collectors of lightweight high-temperature fuel cells

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

P.S.43.

The influence of iron and copper doping on the properties of anodic tungsten oxide layers

Ewa Nowak, Sebastian Kotarba, Karolina Syrek
Department of Physical Chemistry and Electrochemistry, Faculty of Chemistry, Jagiellonian University, Krakow, Poland

9⁴⁵-10⁰⁰ **Break**

INVITED ORAL SESSION, Main Conference Hall

Session V: 10^{00}-12^{20}
Chairpersons: Yury Gogotsi, Ewa Mijowska, Đorđe Janaćković

10^{00} - 10^{20} **I.O.S.2.**

Coupled nanopores for nanofluidic and sensing applications

Marija Drndić
Department of Physics and Astronomy, University of Pennsylvania, Philadelphia, USA

10^{20} - 10^{40} **I.O.S.3.**

Quantifying the total and accessible amount of surface functionalities and ligands on nanomaterials

Isabella Tavernaro, Elina Andresen, Anna Matiushkina, Sarah Abram, Ute Resch-Genger
Div. Biophotonics, Federal Institute for Materials Research and Testing, Berlin, Germany

10^{40} - 11^{00} **I.O.S.4.**

2D/2D heterostructure based on borophene/ MoS_2 for photo-, electro- and photoelectro-catalytic hydrogen evolution – mechanistic insight

Daria Baranowska, Tomasz Kędzierski, Grzegorz Leniec, Beata Zielińska, Ewa Mijowska
Department of Nanomaterials Physicochemistry, Faculty of Chemical Technology and Engineering, West Pomeranian University of Technology in Szczecin, Poland; Center for Advanced Materials and Manufacturing Process Engineering, West Pomeranian University of Technology in Szczecin, Poland

11^{00} - 11^{20} I.O.S.5.

Structure and properties of low dimensional epitaxial oxides; interfaces and superlattices

Gertjan Koster

University of Twente, MESA+ Institute for Nanotechnology, Enschede, Netherlands

11^{20} - 11^{40} I.O.S.6.

Interplay between intra and interparticle effects in multimagnetic nanoarchitectures

A. Omelyanchik[1,2], M. Vasilakaki[3], K. N. Trohidou[3], D. Peddis[1,2]

[1]Department of Chemistry and Industrial Chemistry & INSTM RU, nM2-Lab, University of Genoa, Italy, [2] Institute of Structure of Matter, National Research Council, nM2-Lab, Rome, Italy, [3] Institute of Nanoscience and Nanotechnology, National Center for Scientific Research Demokritos, Athens, Greece

11^{40}–12^{00} I.O.S.7.

Carbonate deprotonation on Ni-rich layered cathode: development of a new cis isomerism oligomer as an organic coverage

Fu-Ming Wang

Graduate Institute of Applied Science and Technology, National, Taiwan University of Science and Technology, Taipei, Taiwan

12^{00} - 12^{20} I.O.S.8.

Bone regeneration - from the first generation of bioinert materials to application of extracellular vesicles (EVs)

Đorđe Janaćković

Faculty of Technology and Metallurgy University of Belgrade, Belgrade, Serbia

12^{20}-15^{00} Break

Second Oral Sessions, Main Conference Hall

Session VI: 15^{00} - 18^{00}
Chairpersons: Petar Uskoković, Gertjan Koster

SYMPOSIUM A:
ADVANCED METHODS IN SYNTHESIS AND PROCESSING OF MATERIALS

15^{00}-15^{15} O.S.II.13.

Stretchable fabric-based flat hydrogels from woven fabrics

Yakup Aykut[1,2], Umit Koc[3,4], Recep Eren[1]

[1]Department of Textile Engineering, Faculty of Engineering, Bursa Uludag University, Bursa, Turkey, [2]Translational Medicine Department, Graduate School of Health Sciences, Bursa Uludag University, Nilufer, Bursa, Turkey, [3]Department of Textile, Clothing, Footwear and Leather, EOSB Vocational School, Fırat University, Elazig, Turkey,[4]Department of Materials Science and Engineering University of California Los Angeles, CA, USA

15^{15} - 15^{30} O.S.II.14.

Gel polymer electrolytes for supercapacitor application

Amrita Jain

Institute of Fundamental Technological Research, Polish Academy of Sciences, Warsaw, Poland

15^{30} - 15^{45} **O.S.II.15.**
Electrocaloric effects in bulk and composite ferroelectrics: synergies of experimental insights and machine learning
Ebru Mensur, Sinem Saclioglu, Cagri Bayir, Namik Gozuacik
Department of Materials Science and Engineering, Gebze Technical University, Kocaeli, Türkiye

SYMPOSIUM B: **ADVANCED MATERIALS FOR HIGH-TECHNOLOGY APPLICATION**

15^{45} - 16^{00} **O.S.II.16.**
Electromagnetic wave shielding effectiveness of the cotton fabrics functionalized with rGO and rGO-$SmVO_4$
Dragana Marinković[1], Slađana Dorontić[1], Sebbache Mohamed[2], Clément Lenoir[2], Kamel Haddadi[2], Svetlana Jovanović[1]
[1]Laboratory for Radiation Chemistry and Physics Gamma, Vinca Institute of Nuclear Sciences, University of Belgrade, Serbia, [2]Univ. Lille, CNRS, Centrale Lille, Univ. Polytechnique Hauts-de-France, UMR 8520 – IEMN, Institut d'Electronique de Microélectronique et de Nanotechnologie, Lille, France

16^{00} - 16^{15} **O.S.II.17.**
From sound to secure qubits: acoustic modulation of single-photon sources
Sanja Đurđić Mijin[1,2], Snežana Lazić[1,3]
[1]Departamento de Física de Materiales, Universidad Autónoma de Madrid, Madrid, Spain,[2]Institute of Physics Belgrade, University of Belgrade, Belgrade, Serbia, [3]Instituto 'Nicolás Cabrera' and Instituto de Física de Materia Condensada (IFIMAC), Universidad Autónoma de Madrid, Madrid, Spain

16^{15} - 16^{30} **O.S.II.18.**
Search for a storage phosphor based on YAP for emerging applcations
Yaroslav Zhydachevskyy[1], Vasyl Stasiv[1], Sergii Ubizskii[2], Oleksandr Poshyvak[2]
[1]Institute of Physics, Polish Academy of Sciences, Warsaw, Poland, [2]Lviv Polytechnic National University, Lviv, Ukraine

16^{30} - 16^{45} **O.S.II.19.**
Cr^{3+}-activated $Ga_2O_3:In^{3+}$ as a NIR source: understanding quenching via photoelectric and thermal studies
Natalia Majewska[1,2], Mu-Huai Fang[3], Sebastian Mahlik[2]
[1]Faculty of Chemistry, Adam Mickiewicz University, Poznan, Poland, [2]Institute of Experimental Physics, Faculty of Mathematic, Physics and Informatics, University of Gdansk, Poland, [3]Research Center for Applied Sciences, Academia Sinica, Taipei, Taiwan

16^{45} - 17^{00} **O.S.II.20.**
Determination of lateral sizes of graphene oxide nanosheets and implications for the 2D/oxides integration
Zoran Jovanović[1,2], Darija Petković[1], Damjan Vengust[2], Sonja Jovanović[1], Lucija Bučar[2], Željko Mravik[1], Marko Jelić[1], Matjaž Spreitzer[2]
[1]Laboratory of Physics, Vinča Institute of Nuclear Sciences, University of Belgrade, Serbia, [2]Advanced Materials Department, Jožef Stefan Institute, Ljubljana, Slovenia

17^{00} - 17^{15} **O.S.II.21.**
Variation of filler size and concentration to optimize the dielectric properties of $SrTiO_3$/LDPE composites for energy storage applications
Biljana Pećanin[1], Slavica Maletić[2], Dragana Grujić[1], Branka Ružičić[1], Dragana Cerović[2,3], Manja Kurečič[4], Alen Erjavec[4], Blanka Škipina[1]
[1]University of Banja Luka, Faculty of Technology, Banja Luka, Bosnia and Herzegovina, [2]University of Belgrade, Faculty of Physics, Belgrade, Serbia, [3]Academy of Technical and Art Applied Studies Belgrade, Belgrade, Serbia, [4]University of Maribor, Faculty of Mechanical Engineering, Maribor, Slovenia

17^{15} - 17^{30} **O.S.II.22.**
Dry-spun carbon nanotube films as patternable and solvent-free counter electrodes for perovskite solar cells
Chae Young Woo[1], Ye-Ji Kim[2], Cheol Woong Choi[2,3], Jin-Woo Oh[1,2,4], Hyung Woo Lee[1,2,4]
[1]Research Center of Energy Convergence Technology, Pusan National University, Busan, Republic of Korea, [2]Humanoid Olfactory Display Innovation Research Center, Pusan National University, Busan, Republic of Korea, [3]Department of Internal Medicine, Pusan National University School of Medicine and Research Institute for Convergence of Biomedical Science and Technology, Pusan National University Yangsan Hospital, Yangsan, Republic of Korea, [4]Department of Nanoenergy Engineering, Pusan National University, Busan, Republic of Korea

17^{30} - 17^{45} **O.S.II.23.**
Enhanced solar-driven hydrogen evolution via C/N-coated TiO_2 nanoparticles produced from $Ti_3C_2T_x$ MXene and gCN
Beata Zielińska, Bartosz Środa, Tomasz Kędzierski, Daria Baranowska, Ewa Mijowska
Department of Nanomaterials Physicochemistry, Faculty of Chemical Technology and Engineering, West Pomeranian University of Technology in Szczecin, Szczecin, Poland

17^{45} - 18^{00} **O.S.II.24.**
Composite materials for multifunctional applications
Andreea Androne [1,2], Teodora Burlanescu[1], Ion Smaranda[1], Adelina Udrescu[1], Radu Cercel[1], Andreea Nila[1], Mirela Vaduva[1], Mihaela Baibarac[1]
[1]National Institute of Materials Physics, Magurele, Romania, [2]University of Bucharest, Faculty of Physics, Magurele, Romania

Thursday, September 4, 2025

Third Poster Session, National Restaurant Jadranka Terrace

Session III: 08^{00} - 09^{45}
Chairpersons: Ivana Dinić, Nemanja Barać

SYMPOSIUM C: **NANOSTRUCTURED MATERIALS**
P.S.44.
Thermal conductivity behavior for some characteristic models of nanostructures in high Tc superconducting ceramics
Jovan P. Šetrajčić
Academy of Sciences and Arts of the Republic of Srpska, Banja Luka, Bosnia and Herzegovina

P.S.45.

The acid activated metakaoline - structural analysis by ssNMR and FTIR spectroscopy

Martina Urbanova[1]; Jiri Brus[1], Ivana Sedenkova[1], Martin Keppert[2]

[1]Department of NMR spectroscopy, Institute of Macromolecular Chemistry, Czech Academy of Sciences, Czech Republic, [2]Czech Technical University in Prague, Faculty of Civil Engineering, Department of Materials Engineering and Chemistry, Praha, Czech Republic

P.S.46.

Visible-light-activated CO_2 photoreduction over ceria-based high-entropy oxide catalysts

Igor Đerđ[1], Dalibor Tatar[1], Stjepan Šarić[1],Jelena Kojčinović[1], András Sápi[2], Ákos Kukovecz[2], Matjaž Finšgar[3],Habib Ullah[4]

[1]Department of Chemistry, Josip Juraj Strossmayer University of Osijek, Croatia, [2]Department of Applied and Environmental Chemistry, University of Szeged, Hungary, [3]Faculty of Chemistry and Chemical Engineering, University of Maribor, Slovenia, [4]Department of Engineering, Faculty of Environment, Science and Economy, University of Exeter, United Kingdom

P.S.47.

Microstructure evolution and tribo-mechanical properties of nano-multilayer TiMoN/NbN coatings

Olga Maksakova[1,2], Vyacheslav Beresnev[2], Serhii Lytovchenko[2], Maria Čaplovičova[3], Martin Sahul[1]

[1]Institute of Materials Science, Slovak University of Technology in Bratislava, Trnava, Slovakia, [2]V.N. Karazin Kharkiv National University, Kharkiv, Ukraine, [3]Centre for Nanodiagnostics of Materials, Slovak University of Technology in Bratislava, Bratislava, Slovakia

P.S.48.

Nanotubes/nanorods of KDP based on AAO matrices

Volodymyr Adamiv[1], Oleh Buryy[2], Yaroslav Shchur[3], Vladyslav Horchynskyi[2], Igor Teslyuk[1], Anatoliy Andrushchak[2]

[1]Ivan Franko National University of Lviv, Lviv, Ukraine, [2]Lviv Polytechnic National University, Lviv, Ukraine, [3]Institute for Condensed Matter Physics, Lviv, Ukraine

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

P.S.49.

Graphitic carbon nitride modified with aromatic compounds for enhanced photocatalytic Cr(VI) reduction

Sofija Petković[1], Jana Petrović[1], Đorđe Janaćković[2], Rada Petrović[2]

[1]Innovation Centre of Faculty of Technology and Metallurgy, Ltd, Belgrade, Serbia, [2]University of Belgrade, Faculty of Technology and Metallurgy, Belgrade, Serbia

P.S.50.

Casting films from cellulose pulp and office paper waste: a sustainable solution for diverse applications

Nemanja Barać[1], Aleksandra Ivanovska[1], Petar Uskoković[2], Đorđe Janaćković[1,2], Ernesto Barceló[3,4], Patrick Gane[2,4], Mirjana Kostić[1]

[1]University of Belgrade, Innovation Center of the Faculty of Technology and Metallurgy in Belgrade Ltd., Belgrade, Serbia, [2]University of Belgrade, Faculty of Technology and Metallurgy, Belgrade, Serbia, [3]Environmental, Social and Governance, Gestamp Automoción S.A., Madrid, Spain, [4]Aalto University, School of Chemical Engineering Department of Bioproducts and Biosystems, Aalto, Helsinki, Finland

P.S.51.

Cu and Ag deposited on pristine and plasma-treated g-C_3N_4: noble *vs.* non-noble metal photocatalysts for Cr(VI) reduction

Jana Petrović[1], Željko Radovanović[1], Bratislav Obradović[2], Đorđe Janaćković[3], Rada Petrović[3]
[1]Innovation Center of the Faculty of Technology and Metallurgy, Ltd, Belgrade, Serbia, [2]University of Belgrade, Faculty of Physics, Belgrade, Serbia

P.S.52.

On tesla-inspired extended quantum-holographic framework for reprogramming macro-quantum correlations of individual and collective consciousness

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

P.S.53.

Assessment of the distribution and origin of heavy metals in sediments of the Vrbas River (Bosnia and Herzegovina)

Sanja Pržulj[1], Gorica Veselinović[2], Sanja Stojadinović[2], Milica Kašanin-Grubin[2], Slobodan Gnjato[1], Branimir Jovančićević[3]
[1]Faculty of Natural Sciences and Mathematics, University of Banja Luka, Banja Luka, Bosnia and Herzegovina , [2]Center of Chemistry, Institute of Chemistry, Technology and Metallurgy, University of Belgrade, Belgrade, Serbia, [3]University of Belgrade, Faculty of Chemistry, Belgrade, Serbia

P.S.54.

Biosafe and bioactive polysaccharide hydrogels with silver nanoparticles for enhancing crops vegetation and soil remediation

Olena Goncharuk[1] , Nataliia Guzenko[2], Yurii Samchenko[1], Svitlana Dybkova[1], Konrad Terpiłowski[3], Katarzyna Szewczuk-Karpisz[4]
[1]Ovcharenko Institute of Biocolloidal Chemistry, NAS of Ukraine, Kyiv, Ukrainee, [2]Chuiko Institute of Surface Chemistry, NAS of Ukraine, Kyiv, Ukraine, [3]Maria Curie-Sklodowska University, Lublin, Poland, [4]Institute of Agrophysics, PAN, Lublin, Poland, Lublin, Poland

P.S.55.

Design of porous zeolite-geopolymer membranes for efficient heavy metal removal from water

Marija Milanović, Mia Andrić, Marija Kovač, Snežana Vučetić, Ivan Stijepović
University of Novi Sad, Faculty of Technology Novi Sad, Department of Materials Engineering, Novi Sad, Serbia

P.S.56.

Production of high-quality hydrochar and value-added liquids from biomass waste via wet torrefaction over zeolite catalysts

Andrii Kostyniuk, Blaž Likozar
National Institute of Chemistry, Department of Catalysis and Chemical Reaction Engineering, Ljubljana, Slovenia

P.S.57.

Reinforced wood–plastic composites: eco-friendly materials from recycled sources

Srđan Perišić[1], Aleksandar Grujić[2], Vukasin Ugrinović[1], Anđela Radisavljević[1], Jovana Ilić-Pajić[2], Jasna Stajić-Trošić[2], Vesna Radojević[3]
[1]University of Belgrade, Innovation Centre, Faculty of Technology and Metallurgy, Belgrade, Serbia, [2]University of Belgrade, Institute of Chemistry, Technology and Metallurgy, Belgrade, Serbia, [3]University of Belgrade, Faculty of Technology and Metallurgy, Belgrade, Serbia

SYMPOSIUM E: **BIOMATERIALS**

P.S.58.

Development and *in vitro* evaluation of starch-gelatin hydrogels for potential cartilage repair

Vukašin Ugrinović[1], Maja Marković[1] , Tamara Matić[2], Nenad Anđelkov[3], Mikael Ivarsson[3], Đorđe Veljović[2]

[1]Innovation Center of Faculty of Technology and Metallurgy, Belgrade, Serbia, [2]Faculty of Technology and Metallurgy, University of Belgrade, Belgrade, Serbia, [3]School of Health Sciences, Faculty of Medicine and Health, Örebro University, Örebro, Sweden

P.S.59.

Towards bio-inspired wound dressings: *Lactobacilli* targeting Gram-negative pathogens

Andrea Osmokrović[1], Vesna Lazić[2], Milos Đuknić[3], Tanja Krunić[4]

[1]University of Belgrade, Faculty of Technology and Metallurgy, Belgrade, Serbia, [2]University of Belgrade, Faculty of Agriculture, Belgrade, Serbia, [3]University of Belgrade, Faculty of Medicine, Belgrade, Serbia, [4]Inovation Center of Faculty of Technology and Metallurgy, Belgrade, Serbia

P.S.60.

Cellulose isolation from wild cyclamen (*Cyclamen purpurascens* Mill.) tubers

Miljana G. Stojanović, Ivan M. Savić , Ivana M. Savić Gajić

University of Niš, Faculty of Tehnology in Leskovac, Leskovac, Serbia

P.S.61.

Materials design for polymer films based on scaling principles and analogies with some bio-membranes

Milanka M. Plavšić[1,2], Zoran S. Petrović[3,4], Jaroslava Budinski-Simendic[5], Milenko B. Plavšić[6,7].

[1]The Academy of Applied Studies-Polytechnic [2]University of Niš, [3]Pittsburg State University, [4]Serbian Academy of Sciences and Arts, [5]University of Novi Sad, [6]University of Belgrade, [7]Engineering Sciences Academy of Serbia, Belgrade

P.S.62.

Preparation and characterization of bioactive nanocomposites curcumin-cationic gemini surfactant-silica

Olga Kazakova, Natalia Lipkovska, Valentyna Barvinchenko

Chuiko Institute of Surface Chemistry, NAS of Ukraine, Kyiv, Ukraine

P.S.63.

Targeting cancer cells by up-converting $NaGd_{0.8}Yb_{0.17}Er_{0.03}F_4$ nanoparticles

Ivana Dinić[1], Miljana Piljević[2], Marina Vuković[1], Marta Bukumira[2], Mihailo D. Rabasović[2], Miloš Lazarević[3], Lidija Mancic[1]

[1]Institute of Technical Sciences of SASA, Belgrade, Serbia, [2]Photonic Center, Institute of Physics Belgrade, University of Belgrade, Serbia, [3]Institute of Human Genetics, School of Dental Medicine, University of Belgrade, Serbia

P.S.64.

Characterization of semicrystalline peptide-based biomaterials

Jiri Brus, Martina Urbanova, Jiri Czernek

Department of Strucuture Analysis, Institute of Macromolecular Chemistry, Czech Academy of Sciences, Czech Republic

P.S.65.
Frontiers in surface engineering: shaping the next generation of titanium-based biomedical implants
Dragana Mihajlović[1], Bojan Međo[1], Veljko Đokić[1,2]
[1]University of Belgrade, Faculty of Technology and Metallurgy, Belgrade, Serbia, [2]Innovation Centre of Faculty of Technology and Metallurgy, Belgrade, Serbia

P.S.66.
Correlation between synthesis parameters and properties of dextran-based hydrogels intended for target delivery of antitumor drugs to the colon
Tamara Erceg[1], Miloš Radosavljević[1], Milorad Miljić[2], Aleksandra Cvetanović[1], Sebastian Baloš[3], Aleksandra Torbica[2]
[1]University of Novi Sad, Faculty of Technology Novi Sad, [2]University of Novi Sad, Institute of Food Technology in Novi Sad,[3] University of Novi Sad, Faculty of Technical Sciences

9^{45} - 10^{00} Break

FOURTH PLENARY SESSION, Main Conference Hall

Session VII: 10^{00}-12^{40}
Chairpersons: Rui L. Reis, Frank Caruso

10^{00} - 10^{40} **PL.S.15.**
New directions in colloidal metal nanoparticle synthesis
Luis M. Liz-Marzán
CIC biomaGUNE, Basque Research and Technology Alliance (BRTA), Spain
Ikerbasque, Basque Foundation for Science, Spain CINBIO, University of Vigo, Spain

10^{40} - 11^{20} **PL.S.16.**
Nanoengineering biomaterials: from assembly to in vivo delivery and function
Frank Caruso
Department of Chemical Engineering, The University of Melbourne, Australia

11^{20} - 12^{00} **PL.S.17.**
Tackling complexity in tissue engineered cell/material interactions and methods to generate different complex in vitro disease models
Rui Luis Goncalves dos Reis
3B's Research Group, I3Bs – Research Institute on Biomaterials, Biodegradables and Biomimetics, University of Minho, AvePark, Zona Industrial da Gandra, Guimarães, Portugal

12^{00} - 12^{40} **PL.S.18.**
Assembly of MXene-based materials with a multitude of functionalities
Yury Gogotsi
A.J. Drexel Nanomaterials Institute, and Department of Materials Science and Engineering, Drexel University, Philadelphia, USA

14.00 Boat-trip around Boka Kotorska Bay

Friday, September 5, 2025

Third Oral Session, Main Conference Hall

Session I: 09^{00} - 11^{30}
Chairpersons: Carla Cannas, Konrad Terpiłowski

SYMPOSIUM B: **ADVANCED MATERIALS FOR HIGH-TECHNOLOGY APPLICATION**

09^{00} - 09^{15} **O.S.III.25.**

Using superplastic forming and diffusion bonding technology for manufacturing aerospace products

Safiullin Rinat

Institute for metals superplasticity problems Russian academy of science, 450001 Russia, 39 Khalturin Street, Ufa

SYMPOSIUM C: **NANOSTRUCTURED MATERIALS**

09^{15} - 09^{30} **O.S.III.26.**

The method of Anomalous SAXS and its application to analyse the Structure and Composition of Nanomaterials

Armin Hoell[1], Susan Schorr[1,2]

[1]Helmholtz-Zentrum Berlin für Materialien und Energie, Berlin, Germany [2]Freie Universität Berlin, Berlin, Germany

09^{30} - 09^{45} **O.S.III.27.**

Functional mesotructures as tunable platforms for CO_2 capture and conversion

Carla Cannas[1], Valentina Mameli[1], Fausto Secci[1], Nicoletta Rusta[1], Mauro Mureddu[2], Elisabetta Rombi[1]

[1]University of Cagliari, Department of Chemical and Geological Sciences, Cittadella Universitaria di Monserrato, Monserrato, CA, Italy, [2]Sotacarbo S.p.A., Grande Miniera di Serbariu, Carbonia, SU, Italy

09^{45} - 10^{00} **O.S.III.28.**

SnO_2 nanofiber thick films for ethanol sensing: preparation, characterization, and performance

Milica Počuča-Nešić[1,2], Katarina Vojisavljević[1], Slavica Savić Ružić[3], Zorica Marinković Stanojević[1,2], Aleksandar Malešević[1,2], Guorong Li[4], Nan Ma[4], Rong Qian[4], Mao Huang[4], Goran Branković[1,2], Zorica Branković[1,2]

[1]University of Belgrade, Institute for Multidisciplinary Research, Belgrade, Serbia, [2]Center of Excellence for Green Technologies, University of Belgrade, Institute for Multidisciplinary Research, Belgrdae, Serbia, [3]Biosense Institute, Center for Sensing Technologies, University of Novi Sad, Novi Sad, Serbia, [4]Shanghai Institute of Ceramics, Chinese Academy of Sciences, Shangai, P.R. China

10^{00} - -10^{15} O.S.III.29.

Mesoporous high-entropy spinel oxide thin films for electrocatalysis of the oxygen evolution reaction

Marcus Einert[1], Arslan Waheed[1], Stefan Lauterbach[2], Maximilian Mellin[1], Marcus Rohnke[3], Lysander Q. Wagner[3,4], Julia Gallenberger[1], Chuanmu Tian[1], Bernd M. Smarsly[3,4], Wolfram Jaegermann[1], Franziska Hess[5], Helmut Schlaad[6], and Jan P. Hofmann[1]

[1]Surface Science Laboratory, Department of Materials and Earth Sciences, Technical University of Darmstadt,Germany, [2]Institute for Applied Geosciences, Geomaterial Science, Technical University of Darmstadt, Germany, [3]Center for Materials Research, Justus-Liebig University Giessen,Germany, [4]Institute for Physical Chemistry, Justus-Liebig University, Heinrich-Buff-Ring 17, 35392 Giessen, Germany, [5]Institute of Chemistry, Technical University Berlin Berlin Germany, [6]University of Potsdam, Institute of Chemistry, Germany

10^{15} - 10^{30} O.S.III.30.

Bridging structure and sensitivity: SnO_2 nanofibers for NO_2 sensing

Katarina Vojisavljević[1], Slavica Savić Ružić[2], Milica Počuča-Nešić[1,3], Zorica Marinković Stanojević[1,3], Guorong Li[4], Nan Ma[4], Rong Qian[4], Mao Huang[4], Goran Branković[1,3], Zorica Branković[1,3]

[1]University of Belgrade, Institute for Multidisciplinary Research, Belgrade, Serbia, [2]Biosense Institute, Center for Sensing Technologies, University of Novi Sad, Novi Sad, Serbia, [3]Center of Excellence for Green Technologies, University of Belgrade, Institute for Multidisciplinary Research, Belgrdae, Serbia, [4]Shanghai Institute of Ceramics, Chinese Academy of Sciences, Shangai, P.R. China

10^{30} - 10^{45} O.S.III.31.

Alginate-montmorillonite composites with effective sorption activity for cationic and anionic dyes and heavy metal ions

Konrad Terpiłowski[1], Nataliia Guzenko[2], Lyudmila Golovkova[2], Olena Goncharuk[3]

[1]Maria Curie-Sklodowska University, Lublin, Poland, [2]Chuiko Institute of Surface Chemistry, NAS of Ukraine, Kyiv, Ukraine, [3]Ovcharenko Institute of Biocolloidal Chemistry, NAS of Ukraine, Kyiv, Ukrainee

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

10^{45} - 11^{00} O.S.III.32.

Decarbonized titanium recovery from bauxite residues

Srećko Stopić[1], Vladimir Damjanović[2], Duško Kostić[3], Mitar Perušić[3], Radislav Filipović[2], Bernd Friedrich[1]

[1]IME Process Metallurgy and Metal Recycling, RWTH Aachen University, Aachen, Germany, [2]Alumina d.o.o., Zvornik, Republic of Srpska, Bosnia and Herzegovina, [3]Faculty of Technology Zvornik, University of East Sarajevo, Zvornik, Republic of Srpska, Bosnia and Herzegovina

SYMPOSIUM E: **BIOMATERIALS**

11^{00} - 11^{15} **O.S.III.33.**

Engineered M13 bacteriophage-based Fabry-Pérot etalon for volatile organic compound detection

Ye-Ji Kim[1], Chae Young Woo[2], Cheol Woong Choi[3], Hyung Woo Lee[1,2,4], Jin-Woo Oh[1,2,4]
[1]Humanoid olfactory display Innovation research Center, Pusan National University, Busan, Republic of Korea, [2]Research Center of Energy Convergence Tehcnology, Pusan National University, Busan,Republic of Korea, [3]Department of Internal Medicine, Pusan National University School of Medicine and Research Institute for Convergence of Biomedical Science and Technology, Pusan National Univerity Yangsan Hospital, Yangsan, Republic of Korea, [4]Department of Nanoenergy Engineering, Pusan National University, Busan, Republic of Korea

11^{15} - 11^{30} **O.S.III.34.**

Comparative study of the photocathalytic activity of TiO_2&CeO_2&Ag and TiO_2&CeO_2&Pd nanocomposites in the destruction of organic dyes

Olena Lavrynenko[1,2], Alisa Atamanchuk[1], Maksim Zahornyi[1], Andrey Ragulya[1,2]
[1]Frantsevich Institute for Problems of Materials Science NASU, Kyiv, Ukraine, [2]Nanotechcenter LLC, Kyiv, Ukraine

11^{30} **Awards and closing of the conference**

12^{00} **Farewell cocktail**

ABSTRACTS

PLENARY LECTURES

MRS-SERBIA 2025 AWARD FOR A LASTING AND OUTSTANDING CONTRIBUTION TO MATERIALS SCIENCE AND ENGINEERING

The role of modern physical metallurgy in alloy development and materials processing

Hamish L. Fraser
Materials Science and Engineering, The Ohio State University

Physical metallurgy is one of the foundational components of materials science and engineering, having been brought out of the blacksmiths' trade by highly gifted scientists, such as Sir Alan Cottrell (e.g., Theoretical Structural Metallurgy, published by Edward Arnold in *1948*). The term “modern physical metallurgy” was first coined by Ray Smallman (Modern Physical Metallurgy, published by Butterworths in *1962*). Since these early days, physical metallurgy has been impacted in a very significant way by (at least) two developments, being firstly advanced techniques for materials characterization and secondly computational materials science. In this talk, examples of the use of (very) modern physical metallurgy in alloy development and metallic materials processing will be given. In the first of these, the application of development of refractory high entropy alloys (RHEA) is considered. In this work, computational materials sciences, primarily involving computational thermodynamics and phase field modeling, has been applied to provide a methodology for the selection of potentially useful RHEAs. Regarding the application of materials characterization, the deformation mechanisms of these alloys have been investigated using a combination of high resolution (scanning) transmission electron microscopy and diffraction contrast techniques. Advances made in the understanding of the behavior of these alloys will be described. Regarding materials processing, two aspects will be discussed. Firstly, the advantages of the application of powder metallurgy, primarily involving the hot isostatic pressing (HIP) of powders, to the processing of RHEAs will be described. This approach involves the use of blends of elemental powders, and an example of this technique will be described. Secondly, the application of the principles of modern physical metallurgy to provide a solution to the application-limiting phenomenon of prior particle boundaries in Ni-based alloys processed using HIP will be described.

PL.S.1.

New methods to grow diamond and cubic boron nitride

Rodney S. Ruoff
Center for Multidimensional Carbon Materials (CMCM), Institute for Basic Science (IBS), Republic of Korea and Department of Chemistry, Ulsan National Institute of Science and Technology (UNIST), Republic of Korea

On Earth (now) significantly more natural graphite (G) than diamond (D) is mined/processed, and significantly more synthetic G than D is made. In metric tons: Natural G (~1,500,000) vs D (~24) and Synthetic G (~3,500,000) vs D (~3,100). D&G are almost isoenergetic at 273K and 1 atm and the same is true for hexagonal boron nitride (hBN) and cubic boron nitride (cBN). A pure carbon sample containing only D&G at chemical equilibrium would have ~22 mol.% D at STP and about 34.5 mol.% at 2000K (per HSC Chemistry). ΔH_f of D at STP is about the same as ΔH_{vap} of liquid neon at its bp of 27K, and about 1/10 the H-bond enthalpy in liquid water. (We recall that graphite is the standard state at STP). My perspective: I will explain that kinetic control and not thermodynamic control dictates why it has been simpler to synthesize G than D at 1 atm pressure. And rather interestingly (if I am correct—and I welcome discussion) in high temperature-high pressure (HTHP) synthesis of D in metal flux it is also kinetic control and not thermodynamic control that favors synthesis of D vs G (pressures in the range 5 – 10 GPa). Almost invariably the explanation for each case (e.g., in textbooks, the published literature, *etc.*) has been based on thermodynamics and I find this "simply wrong" in both cases. I discuss possibilities to synthesize D (please see [1]) in new ways. The parameter space for the elemental compositions of metal fluxes that might dissolve the needed amount of C (or for cBN the needed amount(s) of B and/or N) at ~1 atm pressure is very large as readily obtained from combinatorics and the relevant elements in the Periodic Table. Fortunately (for basic science as well as possibilities for new technologies) there is a great deal that is "not studied at all" about phase equilibria and dissolution of carbon in many possible metal flux choices. I look forward to presenting new ideas about establishing/controlling the spatiotemporal distribution of solute elements in metal flux, from "time = 0" onwards (as the metal flux system evolves, so to speak). With retrosynthesis (inverse design, inverse optimization) and kinetic control rather deeply on my mind, I foresee a new—and very promising— horizon for synthesis of diamond and cubic boron nitride. Supported by the Institute for Basic Science (IBS-R019D1).

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PL.S.2.

Graphene and layered materials for photonics, optoelectronics and quantum technologies

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Graphene and layered materials have great potential in photonics and optoelectronics, where the combination of their optical and electronic properties can be fully exploited, and the absence of a bandgap in graphene can be beneficial. The linear dispersion of the Dirac electrons in graphene enables ultra-wide-band tunability as well as gate controllable third-harmonic enhancement over an ultra-broad bandwidth, paving the way for electrically tuneable broadband frequency converters for optical communications and signal processing. Saturable absorption is observed as a consequence of Pauli blocking and can be exploited for mode-locking of a variety of ultrafast and broadband lasers. Graphene integrated photonics is a platform for wafer scale manufacturing of modulators, detectors and switches for next generation datacom and telecom. These functions can be achieved with graphene layers placed on top of optical waveguides, acting as passive light-guides, thus simplifying the current technology. Heterostructures based on layers of atomic crystals have properties different from those of their individual constituents and of their three dimensional counterparts. The combinations of such crystals in stacks can be used to design the functionalities of such heterostructures, that can be exploited in novel light emitting devices, such as single photon emitters, and tuneable light emitting diodes.

PL.S.3.

2D and 3D Phases of Boron-Carbon-Nitrogen

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The ternary phase space consisting of boron, nitrogen and carbon shows a number of thermodynamically stable phases of binary and ternary compositions. There has been significant amount of work in the past on optimizing conditions to grow these phases and understanding their stability. This talk will focus on some of these interesting materials that have compositions of C, BN, CN and BCN. The effort in synthesizing hexagonal as well cubic phases of these compositions will be discussed with the goal of achieving 2D and 3D structures with specific applications in mind.

PL.S.4.

Synthesis and Properties of Novel Carbon Nanodots

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In recent years, the focus of nanoscience and nanotechnology has gradually shifted from the synthesis of individual components to their assembly into larger systems and materials. The precise organization of matter across multiple length scales is of particular interest due to its significant potential for enabling advanced functions and properties. We have recently developed a simple, scalable, reliable, and cost-effective synthetic method for producing high-quality carbon nanodots (CNDs), using arginine and ethylenediamine as precursors [1,2]. The resulting material exhibits small size and high fluorescence quantum yields. Thanks to the presence of amino groups, CNDs can be easily post-functionalized. By introducing suitably designed functional units, the desired properties can be modulated in a controlled manner from the molecular to the nanoscale level. This approach allows for the synthesis of CNDs with tailored emission properties; for example, green- and white-emitting CNDs have been successfully prepared [3,4]. In addition, the electrochemical properties of specifically designed CNDs can be tuned, and chiral CNDs can be obtained from chirally stable starting materials [4,5]. Finally, CNDs have shown promising performance in organocatalysis, including applications in stereoselective synthesis. In this talk, we will present our latest results in this rapidly evolving field.

Acknowledgement: *Financial support from the European Research Council (ERC ADG-2019, grant nº 885323, is gratefully acknowledged.*

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PL.S.5.

Materials for the future

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Graphene and 2D materials, despite being relatively fresh materials, have already taken a firm place in research, development and applications. A number of exciting phenomena have been discovered in these crystals and they continue bringing exciting results on a regular basis. However, probably the most important characteristic about 2D materials is that they offer a possibility to form on-demand van der Waals heterostructures, where individual 2D crystals are stacked together, forming a novel, 3D structure, which composition (and thus, their properties) can be controlled with atomic precision. This has opened a new directions of research: materials on demand. The properties of the resulting heterostructure can be designed with very high precision. The space of parameters is so large that the use of machine learning methods becomes essential. So, what is next for materials science after the dream of “materials on demand” has been realised? One of the dreams are materials which have some characteristics of biological systems: those with self-healing capabilities, with memory functions, those which can evolve differently depending on external conditions. I will be discussing the methodologies to design such artificial living systems and the areas of their applications.

PL.6.

Colloidal Metal Nanocrystals: Moving from Academic Studies to Industrial Applications

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Although the first documented synthesis of colloidal metal nanocrystals can be traced back to the beautiful work on gold colloids by Michael Faraday in 1856, only within the last decade have methods become available for generating samples with the quality, quantity, and reproducibility needed for a systematic study of their properties as a function of size, shape, and structure, and for exploration of their applications. Of particular importance is to control the shape of colloidal metal nanocrystals, which may initially seem like a scientific curiosity but with implications going far beyond aesthetic appeal. For nanocrystals made of noble metals, the shape determines their chemical, plasmonic, and catalytic properties, as well as their relevance for electronic, photonic and catalytic applications. For more than 20 years, we have been working diligently to understand the nucleation and growth mechanisms leading to the formation of nanocrystals with specific shapes and structures. We have discovered that the shape of metal nanocrystals is dictated by surface capping and the crystallinity and structure of seeds, which are, in turn, controlled by factors such as reduction kinetics and oxidative etching. In this talk, I will discuss some of the recent developments in this field, with a focus on the shape-controlled synthesis of noble-metal nanocrystals under steady-state kinetics. The success of these syntheses has enabled us to tailor the properties of metal nanocrystals for a broad range of applications in photonics, sensing, imaging, medicine, catalysis, and fuel cell technology.

PL.S.7.

Phase Engineering of Nanomaterials (PEN)

Hua Zhang
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In this talk, I will summarize the recent research on phase engineering of nanomaterials (PEN) in my group, particularly focusing on the rational design and synthesis of novel nanomaterials with unconventional phases for various promising applications. For example, by using wet-chemical methods, for the first time, we have successfully prepared novel Au nanostructures (*e.g.*, the hexagonal-close packed (*hcp*) 2H-Au nanosheets, 4H-Au nanoribbons, and 4H/*fcc* and *fcc*/2H/*fcc* heterophase Au nanorods), epitaxially grown metal nanostructures on the aforementioned unconventional Au nanostructures and 2H-Pd nanoparticles, and amorphous/ /crystalline heterophase Pd, PdCu, Rh and Rh alloy nanosheets. By using gas-solid reactions, metastable 1T'-phase group VI transition metal dichalcogenides (TMDs), *e.g.*, WS_2, WSe_2, MoS_2, $MoSe_2$, $WS_{2x}Se_{2(1-x)}$ and $MoS_{2x}Se_{2(1-x)}$, have been prepared. Impressively, the 1T'-MoS_2-supported single-atomically dispersed Pt (s-Pt) atoms with Pt loading up to 10 wt.% exhibit superior performance in hydrogen evolution reaction. Importantly, 1T'-TMD monolayers can be stabilized on 4H-Au nanowires, which have been used for ultrasensitive SERS detection. Moreover, the salt-assisted 2H-to-1T' phase transformation of TMDs have been achieved, and the phase transformation of TMDs during our developed electrochemical Li-intercalation process has been observed. Impressively, the lithiation-induced amorphization of $Pd_3P_2S_8$ has been achieved. Currently, my group focuses on the investigation of (crystal) phase-dependent physicochemical properties, functions and applications in catalysis, (opto-)electronic devices, clean energy, chemical and biosensors, surface enhanced Raman scattering, photothermal therapy, *etc.*, which we believe are quite unique and very important not only in fundamental studies, but also in future practical applications. Importantly, the concepts of phase engineering of nanomaterials (PEN), crystal-phase heterostructures, and heterophase materials are proposed.

PL.S.8.

Halide perovskites: Pioneering materials for clean energy and advanced technologies

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In this talk, I will focus on the pioneering work my group has done on halide perovskites and their transformative impact on solar cell technologies and radiation detectors. Our discovery that these materials can be used a solid solar cell in 2012 has revolutionized the field of photovoltaics, enabling solar cells to achieve power conversion efficiencies that rival traditional silicon-based systems. By introducing perovskites with tunable properties, low production costs, and compatibility with flexible, lightweight substrates, we have pushed solar technology into new realms, making renewable energy more accessible and efficient. Beyond their influence on solar cells, halide perovskites have had a profound impact on radiation detection technology. We successfully leveraged their unique electronic structure to create highly sensitive gamma-ray and X-ray detectors, demonstrating excellent energy resolution for medical imaging, security screening, and nuclear detection applications. These devices have the potential to redefine how we detect and respond to radiation, offering more precise, reliable, and cost-effective solutions. At the heart of these innovations is chemical synthesis, which plays a fundamental role in advancing society by enabling the creation of new materials with tailored properties. Through careful design and synthesis, we can engineer materials to solve critical global challenges, from clean energy generation to advanced medical technologies. Chemical synthesis not only fuels scientific discoveries but also drives technological advancements that improve the quality of life. In this talk, I will highlight how our work exemplifies the broader importance of chemistry in society, shaping technologies that have the potential to transform industries and provide sustainable solutions to pressing environmental and technological needs.

PL.S.9.

Accelerating Catalyst Design for Sustainable Energy Future

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Hydrogen as a clean and versatile energy carrier has the potential to decarbonize various sectors, including transportation, industry, and energy generation. It plays a crucial role in reducing greenhouse gas emissions and advancing the transition toward a more sustainable and environmentally friendly energy future. Electrocatalysis plays a central role in hydrogen energy technologies. Despite significant progress, many electrocatalytic systems, such as hydrogen fuel cells, continue to face challenges related to insufficient catalytic efficiency, poor stability, and the high cost of precious metal catalysts. Rapidly advancing beyond trial-and-error methods is imperative to address the imminent energy and climate crisis. This presentation will delve into the development of experimentally attainable descriptors capable of predicting the catalytic activity and stability of catalysts, which facilitates the accelerated discovery of more efficient catalysts. Furthermore, we will explore practical catalyst structure design, tailored to enhance both catalyst activity and stability in full-cell operation, thereby maintaining the overall performance of the device.

PL.S.10.

Supramolecular Plastics for a Sustainable Future

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One of the major issues causing environmental destruction is plastic waste. Between the years 1950 and 2015, we produced 8.3 billion tons of plastic, yet less than 9% was recycled. 6.3 billion tons became waste, either incinerated or discarded into the natural environment. When burned, plastic emits carbon dioxide, which accelerates global warming. When discarded, plastic degrades into microplastics, which spread not only in the oceans but also in the air and soil, harming ecosystems—including humans. Recent studies have reported that microplastics, once inside the human body, can pass through the blood-brain barrier and cause various diseases. While many strategies, such as improving plastic materials, have been explored to address the plastic waste problem, we believe a fundamentally new strategy is necessary. We focused attention on the concept of supramolecular polymers, which I have tightly committed from the beginning. At the end of November 2024, we reported supramolecular plastics [11], as a strategic extension of the concept of supramolecular polymers using salt-bridge-forming ionic monomer pairs. This new class of polymeric materials disassembles into monomers when exposed to salts in the natural environment and is then metabolized by microorganisms. Unlike conventional plastics, supramolecular plastics do not generate microplastics. Despite their eco-friendly characteristics, these plastic materials possess mechanical properties that are comparable or even better than those of conventional plastics.

What we have done with supramolecular plastics are listed below. (1) Green synthesis by mixing two monomers in water at ambient temperatures, (2) monomers derived from natural resources are usable, (3) non-genotoxic, (4) colorless and glass-like transparency, (5) non-flammable with no emission of carbon dioxide, (6) exceptionally high mechanical strength, (7) ultra-high density (1.71 g/cm^3) achievable, (8) no weight loss up to 315 °C, (9) thermoplastic properties though with a three-dimensional crosslink, (10) self-healing ability to repair structural damage, (11) dissociate in seawater into monomers that are metabolizable, (12) dissociate in soil into monomers that are metabolizable, (13) contains P, N, and S useful for a soil conditioner, and (14) applicable to 3D printing technology.

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PL.S.11.

Novel materials for nanosized drug delivery systems

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Ideally, nanosized drug-loaded pharmaceutical carrier should: (a) accumulate in required organ or tissue, and (b) penetrate inside target cells delivering there its load. Organ or tissue (tumor, infarct) accumulation could be achieved by the passive targeting via the enhanced permeability and retention effect or by the specific ligand(antibody)-mediated active targeting, while the intracellular delivery could be mediated by certain internalizable ligands or by cell-penetrating peptides. To be able to behave this way, drug carrier should simultaneously carry on its surface various moieties capable of functioning in a certain orchestrated order. Within the frame of this concept, multifunctional stimuli-responsive materials for nanocarriers are developed, i.e. nanocarriers are prepared that, depending on the particular requirements, can circulate long; target the site of the disease via non-specific and/or specific mechanisms; respond local stimuli characteristic of the pathological site by, for example, releasing an entrapped drug or deleting a protective coating facilitating thus the contact between drug-loaded nanocarriers and target cells; and even provide an enhanced intracellular delivery of an entrapped drug with its subsequent delivery to specific intracellular organelles. Such carriers can be additionally supplemented with reporter moieties to follow their real-time biodistribution and target accumulation. Among new developments to be considered are: drug- or/and RNA-loaded delivery systems additionally decorated with cell-penetrating peptides for the enhanced intracellular delivery; "smart" multifunctional drug delivery systems, which can reveal/expose temporarily hidden functions under the action of certain local stimuli characteristic for the pathological zone (such as lowered pH, redox-conditions, hypoxia, or locally increased expression of certain enzymes); new means for controlled delivery and release of siRNA; approaches for intracellular drug delivery and organelle targeting; and application of nanocarriers co-loaded with siRNA and drugs to treat multidrug resistant tumors.

PL.S.12.

Designing, Constructing, and Uniformly Accessing Arrays of Clusters of Atomically Precise Composition for Heterogeneous Catalysis of Chemical Reactions

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For many gas-phase chemical and condensed-phase electrochemical reactions, rate acceleration by heterogeneous catalysts is indispensable. Such catalysts often rely upon precious-metal components. Further, they often comprise non-uniform collections of active sites, i.e. sites presenting differing facets, geometries, and/or numbers of functional atoms, situated on non-uniform supports and residing in non-uniform chemical & physical environments. Non-uniformities can greatly complicate both characterization of catalyst structures and elucidation of catalysis mechanisms. The resulting uncertainties weaken links between theory and experiment, obscure structure/activity correlations, and impede exploitation of computational methods to design or discover superior catalysts. Desirable would be much more chemically & structurally ideal collections of heterogeneous catalysts.This presentation focuses on the synthesis of uniformly supported and distributed arrays of catalytic clusters having atomically precise compositions. Array organization is based upon installing clusters into size-matched pores of crystalline metal-organic framework (MOF) materials. Notably, the employed MOFs are reasonably thermally stable (~580K in air) and chemically robust (e.g., retention of crystallinity & porosity following prolonged exposure to steam or corrosive media). Catalysts of most interest to us are: a) polyoxometalates (POMs), presented in gas-phase environments, and b) previously unknown polythiometalates (PTMs) that are functionally reminiscent of enzymes having competency for reduction reactions. Representative catalytic reactions are CO_2 to methanol; semi-hydrogenation of alkynes via H_2-derived, sulfur-vacancy-stabilized, metal hydrides; and electrochemical reduction of $^{15}N_2$ to $^{15}NH_3$ at ambient temp. and pressure, via the intermediacy of water-derived hydrides. DED (difference electron density) measurements inform about catalyst accessibility and about active-site steric & chemical environments. Detailed catalyst structural information is obtainable from *disordered* arrays by combining the results of computational modeling (Getman, Ohio State Univ.) and experimental pair-distribution function analysis of total-X-ray-scattering (Chapman, Stony Brook Univ.). Rxn. rates, orders, and product distributions; *operando* spectroscopy; and DFT modeling, provide information about catalytic mechanisms and inform design of new catalysts.

PL.S.13.

Repairing and upcycling of electrode materials from spent lithium-ion batteries

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Electrical energy storage is becoming more and more important due to the widespread use of electrical vehicles and large-scale storage of electricity from wind farms and solar power plants. Lithium-ion batteries are taking a dominant role in these fields, and their consumption is exponentially increasing. However, the major elements of lithium, cobalt, nickel, etc, used in lithium-ion batteries are either rare or geographically unbalanced. Therefore, it is essential to recycle these substances greenly and efficiently. We have made great efforts to directly recycle and then reuse the electrode materials from spent lithium batteries in a green, cost-effective, and short-processing ways. For example, we have developed upcycling transformation strategy, subtractive transformation strategy, and multi-functional transformation strategy of cathode materials from spent lithium ion batteries, with excellent feasibility based on technical economic analysis.

PL.S.14.

Stress-dissipation strategy stabilized solid oxide cathodes for high-performance all-solid-state lithium batteries

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The electrochemical-mechanical instability of single-crystalline Ni-rich oxide cathode associated with stress variation during lithium (de)lithiation poses a substantial barrier to the operation of high-energy density and fast charging in the all-solid-state lithium batteries (ASSLBs). Here we report an approach that suppresses the electrochemical-mechanical degradation using the integration of an innovative stress dissipation into Ni-rich oxides, which involves a F-doped bulk structure and island-like sticky SiO_2 gel on the surface of Ni-rich oxides through a simple washing process. F ions realize a stable interlayer structure manifested in its strong interactions with transition metals and oxygen, effectively constraining detrimental structure deformation to retardate stress redistribution during (de)lithiation. The island-like sticky gel clusters allow local stress gradient formation on the surface to drive the particle rotation, responsible for the main stress dissipation during long-term cycling. The oxide cathode design enables the sulfide-based ASSLBs to achieve a high specific capacity of 192 mAh g^{-1} on charging at 0.1 C while still maintaining 45 mAh g^{-1} at 10 C. Notably, the assembled sulfide-based ASSLB demonstrates superior cycling stability over 1000 cycles with 98 % capacity retention at 2 C. This generalizable approach offers insights into the stress dissipation path on the electrochemical-mechanical stability of solid oxide cathodes, opening up a new avenue for ASSLBs to achieve high energy density, fast charging capability, and long durability.

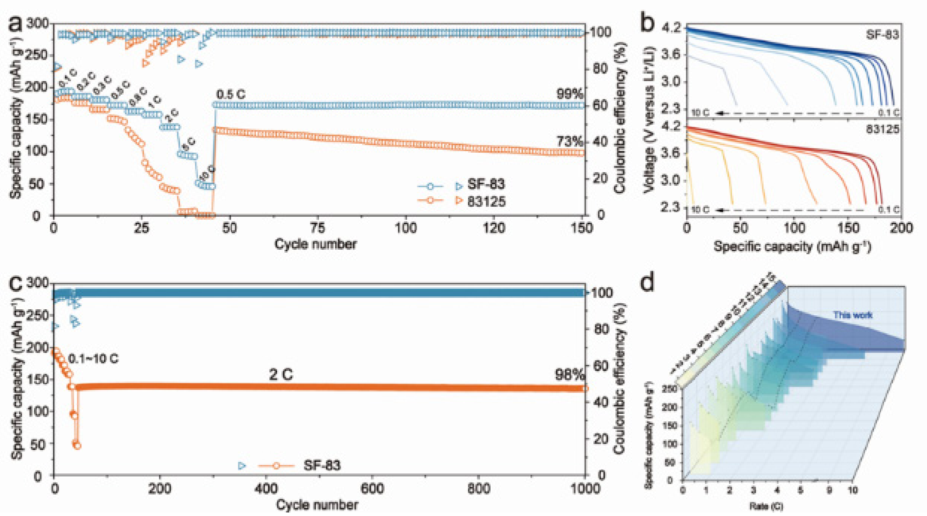

Figure 1. Electrochemical performance of ASSLBs at 30 ºC. a, Electrochemical rate capabilities. b. Galvanostatic discharge profiles of 83125 and SF-83 cathodes at various current rates. c. Long-term cycling performance of SF-83 at 2 C rate; d, Comparison of rate capability between the all-solid-state batteries assembled with SF-83 and previously reported Ni-rich oxide cathodes.

PL.S.15.

New Directions in Colloidal Metal Nanoparticle Synthesis

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This lecture will highlight recent advances in the synthesis of plasmonic nanoparticles, including novel methods for the synthesis of optically active plasmonic nanomaterials and in situ growth on arbitrary surfaces. Although much research has been reported on the use of colloid synthesis to control the size and shape of metal nanoparticles and their influence on plasmonic properties, a strong rejuvenation has recently come along the observation of plasmonic optical activity in chiral plasmonic nanoparticles [1,2]. In particular, it has been demonstrated that the well-known seeded-growth method can be employed to endow colloidal nanoparticles with chiral morphological features. Various approaches will be introduced, comprising either the use of chiral amino acids [3] or the self-organization of surfactant micelles into chiral structures on nanoparticle seeds [4]. These concepts open up a wide range of possibilities, by playing around with the variety of potential chiral co-surfactants, seed morphologies and metal compositions, which have been studied in the context of the seeded growth of metal nanoparticles [5]. On the other hand, recent progress has also expanded knowledge and increased the degree of control over the morphologies of metal nanoparticles grown on solid and soft substrates [6,7]. A promising prospect goes in the direction of combining these methods to grow chiral nanostructures on arbitrary substrates.

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PL.S.16.

Nanoengineering Biomaterials: From Assembly to *In Vivo* Delivery and Function

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Advances in nanoparticle-mediated therapeutic delivery are poised to revolutionize disease treatment and prevention. In particular, the formulation of mRNA into lipid nanoparticles to combat COVID-19 has highlighted the transformative potential of nanoparticle platforms in the pharmaceutical industry and clinical practice. However, distinct types of therapeutics are required to meet specific therapeutic purposes, and their encapsulation is typically tailored on a case-by-case basis. This presentation will present a versatile and biomaterial-based nanoparticle platform, whereby diverse therapeutics, including functional small molecules, siRNA, mRNA, and proteins, can be readily assembled into nanoparticles. The encapsulated therapeutics maintain their intrinsic activity and can be released upon exposure to the biological milieu. This nanoparticle platform has potential for usage in a range of applications.

PL.S.17.

Tackling Complexity in Tissue Engineered Cell/Material Interactions and Methods to Generate Different Complex *In Vitro* Disease Models

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The selection of a proper material to be used as a scaffold, as a proper matrix, or as a bioink in 3D bioprinting approaches to support or encapsulate cells is both a critical and a difficult choice that will determine the success of failure of any tissue engineering and regenerative medicine (TERM) strategy. In our research group we have been mainly using natural origin polymers, including a wide range of marine origin materials, for many different approaches that allow for the regeneration of different tissues. Several innovative bioinks with quite specific properties were developed and proposed for several specific uses. We have also been optimizing the respective formulations for using these novel materials in distinct biomanufacturing strategies. Furthermore, an adequate cell source should be selected. In many cases efficient cell isolation, expansion and differentiation methodologies should be developed and optimized. We have been using different human cell sources namely: mesenchymal stem cells from bone marrow, mesenchymal stem cells from human adipose tissue, human cells from amniotic fluids and membranes and cells obtained from human umbilical cords. The potential of each biomaterials/ /cells combination and respective concentrations, as related to different manufacturing technologies, with details when appropriated focusing on bioprinting, to be used to develop novel useful regeneration therapies will be discussed. Several examples of TERM strategies to regenerate different types of tissues will be presented. The use of different cells and new ways to assess their interactions with different natural origin degradable scaffolds and bioinks will be described. A unique high-throughput platform to better understand material/cells interactions and optimise their performance and biological performance will be discussed. This rather innovative platform is based on the use of unique microfluidics-based approaches and allows for the engineering of novel complex *in-vitro* models, including disease tissue models.

PL.S.18.

Assembly of MXene-Based Materials with a Multitude of Functionalities

Yury Gogotsi
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More than 40 stoichiometric MXene compositions and dozens of solid solutions and structures with various terminations have been reported since the first report on $Ti_3C_2T_x$ in 2011. The number of possible compositions is infinite if one considers solid solutions (more than 50 have been made in our lab) and combinations of surface terminations. New subfamilies of in- and out-of-plane ordered MXenes, oxycarbides, 2D borides, and silicides further expand the family of non-oxide 2D materials based on transition metals. MXenes have also opened an era of computationally driven atomistic design of 2D materials, and we are only starting our journey into the world of atomistically designed materials. MXenes possess electronic, optical, mechanical, and electrochemical properties that differentiate them from other materials. MXenes are 2D building blocks for assembling functional materials and devices that will power future technologies. Chemically tunable superconductivity has been demonstrated in Nb- and Mo-based MXenes. Highly nonlinear optical properties of MXenes are being explored. Several MXenes have been predicted to act as topological insulators. Many MXenes are metallic conductors but with a tunable density of states at the Fermi level, like in semiconductors. Moreover, their properties are tunable by design and can be modulated using an ionotronic approach, leading to breakthroughs in the fields ranging from optoelectronics, electromagnetic interference shielding, and communication to energy storage, catalysis, sensing, and healthcare. In several applications, such as electromagnetic interference shielding and thermal insulation, MXenes have already outperformed all other materials. In this talk, I'll discuss the emerging synthesis methods of MXenes, the effect of synthesis on composition and properties, and the assembly of MXenes into functional films and coating. Co-assembly with graphene and other nanomaterials will also be discussed, and prospects for applications of MXene-based materials in fields ranging from electronics to healthcare, thermal management, communication, and energy generation and storage will be outlined.

Invited
Oral Presentations

I.O.S.1.

Advancements in Thin Film Oxides: Exploring Interface Functionalities

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Complex oxides exhibit a wide range of fascinating functionalities, such as ferroelectricity, piezoelectricity and pyroelectricity, which are indispensable for cutting-edge electronics, energy, and information technologies. The intriguing physical properties of these complex oxides arise from the complex interplay between lattice, orbital, charge, and spin degrees of freedom. Here, I will provide an overview of our recent results of how the properties of oxide heterostructure can be tuned by artificially breaking the symmetry of ferroelectric, piezoelectric, electrostriction and pyroelectric materials. Additionally, I will explore innovative approaches that have made it possible to produce ultrathin, freestanding oxide films that approach the two-dimensional limit. This array of advancements presents unique opportunities for harnessing the rich and novel functionalities of complex oxides and their interfaces.

I.O.S.2.

Coupled Nanopores for Nanofluidic and Sensing Applications

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Beyond atomically thin 2D materials and nanopores, I will discuss the “coupled”, guiding, and reusable bilayer nanopore platforms (“GURU”), enabling advanced ultrafast detection of unmodified molecules. Nanopores are nanometer scale holes in materials that allow passage of ions and molecules and their respective detection via changes in electrical signals. In this talk I will discuss new nanopore designs, beyond a single pore, that contain two layers of nanopores, allowing for added functionalities. We designed a bottom layer of nanopores that can collimate and decelerate the molecules under detection, and the top 2D pore enables accurate sensing of molecules passing by. We varied the number of pores in the bottom layer while fixing one 2D nanopore in the top layer. When the number of pores in the bottom layer is reduced to one, sensing is performed by both layers, and distinct T- and W-shaped electrical signals indicate the precise position of molecules and are sensitive to fragment lengths of molecules being detected. This is enabled by microsecond resolution capabilities and precise nanofabrication. Coupled nanopores present configurable systems for better electromechanical control and prolonged detection times.

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I.O.S.3.

Quantifying the Total and Accessible Amount of Surface Functionalities and Ligands on Nanomaterials

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Engineered nanomaterials (NMs) of various chemical composition and surface functionalization are routinely fabricated for industrial applications such as medical diagnostics, drug delivery, sensing, catalysis, energy conversion and storage, opto-electronics, and information storage. NM dispersibility, stability, processability, and function as well as the interaction with biological species and environmental fate are largely determined by NM surface functionalities, i.e., functional groups (FGs) and ligands. Therefore, reliable, reproducible, and eventually standardized surface characterization methods are vital for quality control of NMs, and mandatory to meet increasing concerns regarding their safety. Suitable methods for determining surface functionalities on ligand-stabilized core and core/shell NPs include advanced techniques such as traceable quantitative nuclear magnetic resonance (qNMR) as well as X-ray electron spectroscopy (XPS) and time of flight secondary ion mass spectrometry (ToF-SIMS), and simpler optical and electrochemical methods.[1] The latter less costly and fast methods, which can be automated, are often used by NM producers for process and quality control.[1,2] To validate methods, establish measurement uncertain-ties, test reference materials, and produce reference data, multi-method characterization studies are needed.[3,4] as well as interlaboratory comparisons (ILC) on determining NM surface chemistry and well characterized test and reference NMs providing benchmark values.[5,6] Here, we present examples for quantifying common surface FGs such as amino and carboxyl groups on functional NMs of different chemical composition such as silica, polymer, iron oxide, and lanthanide-based upconversion nanoparticles with optical assays, electrochemical titration methods, qNMR, and chromatographic separation techniques. In addition, ongoing interlaboratory comparisons will be presented.

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I.O.S.4.

2D/2D heterostructure based on borophene/ MoS_2 for photo-, electro- and photoelectro-catalytic hydrogen evolution – mechanistic insight

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The urgent need for sustainable energy solutions has driven extensive research into solar-driven hydrogen production via photoelectrochemical (PEC) processes. Molybdenum disulfide (MoS_2) has emerged as a promising catalyst due to its excellent electronic and catalytic properties. The recent discovery of borophene, a new two-dimensional (2D) boron-based material with remarkable electronic characteristics and tunable band structures, presents a unique opportunity to enhance MoS_2-based PEC performance. In this presentation, I will introduce the fabrication, characterization, and application of borophene/molybdenum disulfide (B/MoS_2) 2D/2D heterostructures for efficient hydrogen evolution. The study explores their catalytic performance in photo- (photo), electro- (HER), and photoelectro- (PEC) catalytic hydrogen evolution reactions under acidic conditions. Moreover, in-situ and ex-situ material characterization techniques were employed to elucidate the underlying reactions mechanisms. Our results show that optimizing the MoS_2-to-borophene mass ratio significantly enhances PEC performance, reducing the overpotential to 281.1 mV with a Tafel slope of 56.0 mV/dec, substantially improved from 312.5 mV and 160.9 mV/dec in conventional HER. Moreover, long-term stability tests at a constant current density of 10 mA/cm^2 confirm the exceptional durability of B/MoS_2, maintaining stable hydrogen evolution performance for over 120 hours. The hydrogen evolution rate reached ~2.5 mol/g in PEC, representing a 1.4-fold, 1.8-fold, and 3152-fold increase compared to pristine MoS_2 in the photoelectro-, electro-, and photo-catalytic hydrogen evolution process, respectively. The comprehensive material characterization highlighted the potential of borophene-enriched MoS_2 as an efficient catalyst for solar and/or electricity-driven hydrogen production, confirming that borophene presence substantially promotes the 2H-to-1T phase transition of MoS_2 by creating strain and defects, destabilizing the 2H phase, and favoring the formation of the 1T phase, thus significantly enhancing catalytic performance. This work underscores the potential of MoS_2/borophene heterostructures as next-generation catalysts for solar-driven hydrogen production. The findings provide valuable insights into designing advanced catalytic materials for clean energy applications and contribute to the broader efforts toward developing efficient and scalable PEC systems.

I.O.S.5.

Structure and properties of low dimensional epitaxial oxides; interfaces and superlattices

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In complex oxide materials the occurrence of ferroelectric, ferromagnetic or other properties are for the most part determined by the detailed (oxygen) coordination of metal cations. More specifically, in the case of perovskite-type materials ABO_3, where A and B are metal cations, by the BO_6 octahedral orientations and rotations. At interfaces in epitaxial oxide hetero structures, for example magnetic junctions or capacitive structures, this oxygen sub-lattice is found to be different from its bulk counterpart. I will briefly introduce the status of the often-used technique to fabricate epitaxial layers, 'atomically controlled PLD', as well as give a few examples of oxygen sub-lattice and interface engineering achieved by controlled thin film parameters such as, composition, digital thickness variation, polar discontinuous interfaces or the insertion of oxide buffer layers that influence the perovskite-type BO_6 sub-lattice or related structures. I will further elaborate on the effects of such thin film parameters on the structure and properties of various model systems that have been subsequently studied by in situ characterization techniques and high-resolution scanning transmission electron microscopy. More practically, often-encountered problems due to dead-layer effects and interfacial issues when integrating oxides with technical platforms such as Si or GaN, will be discussed.

Keywords: thin films, perovskites, transition metal oxides, crystal symmetry

I.O.S.6.

Interplay between intra and interparticle effects in multimagnetic nanoarchitectures

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Multi-Magnetic Nanoarchitecture exhibits distinctive and peculiar physical properties making them uniquely suitable for advanced technological and biomedical applications. Among various designs, bi-magnetic core/shell nanoarchitecture composed of spinel ferrites stand out due to their tunable magnetic responses arising from the interplay of intra- and interparticle effects. This talk focuses on the magnetic behavior of bi-magnetic core/shell nanoarchitectures, composed of cobalt ferrite ($CoFe_2O_4$, CFO) and nickel ferrite ($NiFe_2O_4$, NFO) in both direct (CFO/NFO) and inverse (NFO/CFO) configurations. Systematic variation of shell thickness and particle architecture significantly affects magnetic properties (i.e., magnetic anisotropy, saturation magnetization, and magnetization dynamics). Observed effects cannot be fully described by simple additive models, pointing to a complex interaction between magnetic intraparticle (proximity effect) and interparticle interactions. Experimental insights obtained using remanent magnetization analyses (Δm-plot) and supported by Monte Carlo simulations allow us to unravel this intricate interplay, underscoring the importance of nanoscale architecture. We also discuss several critical open questions: the mechanisms through which intraparticle and interparticle interactions influence each other; the distinct roles of dipolar and exchange interparticle interactions; the impact of core/shell nanoparticle architecture, including core and shell materials, layer dimensions, and shape; and how these interactions can be harnessed for designing materials with tailored magnetic properties. [1,2].

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I.O.S.7.

Carbonate deprotonation on Ni-rich layered cathode: Development of a new cis isomerism oligomer as an organic coverage

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Ni-rich layered cathodes have a high practical capacity (>200 mAh·g^{-1}) and tapped density (>3.6 mg·cm^{-2}), thus attracting wide attention in large applications such as electric vehicles and energy storage. However, high surface reactivity of these cathodes promotes the decomposition of carbonates solvents, which contributes to the growth of the cathode–electrolyte interphase (CEI) as well as rapid fading of the battery's capacity during long-term cycle. Carbonates are favorable for deprotonation reaction by the oxygen atom in the Ni-rich layered cathode and further in the formation of the CEI. In this study, the deprotonation mechanism of cyclic and linear carbonates on a Ni-rich layered cathode was thoroughly investigated using operando Fourier-transfer infrared spectroscopy, and the reasons for cathode fading could be confirmed in terms of the carbonate structures. In addition, a new maleimide oligomer was developed and covered on a Ni-rich layered cathode to inhibit the deprotonation of the carbonates. The maleimide oligomer acts as a cis isomerism that provides a bridge function for reacting with oxygen on the cathode surface by its cis formulation. Moreover, this bridge function will keep the carbonates away from the cathode surface for further decomposition during cycling. On the contrary, the battery performance exhibited a cycling ability at a high rate, and the new cis isomerism maleimide oligomer helped improve the rate capability. A full-cell (>3 Ah) test containing graphite as the anode with a cis formulation of the maleimide oligomer coverage was completed.

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I.O.S.8.

Bone regeneration - from the first generation of bioinert materials to application of extracellular vesicles (EVs)

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The first generation of biomaterials - bioinert materials were developed with the goal to achieve a suitable combination of physical properties with the minimised toxic and immune response to the foreign body. The second generation of biomaterials - bioactive materials provide cellular reaction such as colonization of osteoblasts, proliferation and differentiation of the cells to form new bone. Third generation biomaterials were designed to stimulate specific cellular responses at molecular level and to activate genes that stimulate regeneration of living tissues. Two alternative routes of repair are now available with the use of these biomaterials: tissue engineering and *in situ* tissue regeneration. A recent trend based on latter approach for reconstruction of bone defects is combination of biocompatible scaffolds with embedded bioactive components such as extracellular vesicles (EVs), derived from mesenchymal stem cells (MSCs), as a "cell-free therapy approach". In this presentation, the focus will be on the differences of the osteogenic/osteoinductive properties and cytocompatibility of the first generation of biomaterials such as Ti-based scaffold, and contemporary approaches such as the application of extracellular vesicles (EVs) in combination with biomaterials. We compared the 3D-printed Ti6Al4V scaffold and 3D-printed Ti6Al4V scaffold functionalized with ceramic coatings and extracellular vesicles (EVs) derived from stem cells of human exfoliated deciduous teeth (SHED cells) embedded in a collagen hydrogel. Cytocompatibility tests of these biomaterial constructs showed a higher metabolic rate of SHED cells on coated scaffolds compared to uncoated Ti scaffolds. Further, the osteogenic potential of EV-loaded scaffolds was tested on autologous SHED cells for 10-day period. The qRT-PCR analysis revealed significant upregulation of RUNX-2 and BMP-2 gene expression compared to non-functionalized Ti6Al4V scaffold indicating the pro-osteogenic effects of the SHED-EV-enriched scaffold. These findings suggest that the integration of SHED-derived EVs within a functionalized Ti scaffold is a promising strategy for enhancing bone regeneration in critical-sized defects.

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Oral Presentations

O.S.I.1.

The influence of yellowing of the recycled plastic surfaces on their dyeing

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The aim of the work is to investigate the effect of yellowing (degradation, ageing) of plastics materials on their dyeing. The analyzed plastics were the mixture of HIPS and ABS from recycled refrigeration equipment. Three 1 kg samples (white, semi-yellow and yellow flakes) were manually prepared from which reference samples (undyed standardized specimens-dumbbells) and dyed standardized specimens were obtained. Using the laboratory injection molding machine, HIPS/ABS samples (white HIPS/ABS, semi-yellow HIPS/ABS and yellow HIPS/ABS) were dyed in the following colors: orange, red and green. The degree of coloring of the standardized specimens was determined using the colorimeter and the "L", "a" and "b" parameters. Additionally, white dyeing tests (lightening of standardized specimens) were performed. The standardized specimens before and after dyeing were also subjected to ATR-FTIR, MFI, mechanical properties, optical topography and wetting angles tests.

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O.S.I.2.

Analysis of microstructure and mechanisms of plastic deformation of high-strength Mg-Zn-Y alloys

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Present work is focused on revealing deformation mechanisms resulting in high-strength and moderate elongation of the Mg-0.56Zn-1.5Y (at.%) alloys prepared by rapidly solidified ribbon consolidation technique. The processing method alongside with low alloying content results in a fine- grained microstructure with Zn- and Y-rich stacking faults formed in the basal planes. In addition, the extruded from cast ingot alloys of the same composition, characterized by homogeneous microstructure with large gains and presence of long-period stacking order (LPSO) phase have been used as reference material. The latter alloys are showing better ductility, but lower strength compared to the rapidly solidified ribbon consolidated alloys. Besides, the effect of extrusion ram speed on microstructure and resulting mechanical properties is addressed. Microstructure observations have been performed using light and scanning electron microscopy. Lower values of yield strength in tension compared to that in compression motivated further detailed investigation using advanced technique. Thus, *in-situ* synchrotron X-ray diffraction method has been employed for analysis of the deformation mechanisms, indicating the activation of non-basal slip systems alongside the primary basal slip system, with negligible twinning. Particular attention has been paid to revealing background mechanisms of yield point phenomenon.

O.S.I.3.

Ablative-Oxidative LIPSS generation on Si: theory and applications

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Laser-induced periodic surface structures (LIPSS) have already found numerous applications in for enhancement of photocatalytic activity and surface plasmon resonance, CO_2 and GO reduction, improving osteointegration and many others [1,2], but still demonstrate a huge potential for development of new approaches in traditional and newly evolving technological fields. The LIPSS was used to control surface wettability, im-prove adhesive properties, modify friction, change optical properties and enhance electron emis-sion, to name but a few. A major mechanism of LIPSS formation in metals, semiconductors, and dielectrics is attributed to interference of an incident laser beam and one or another kind of a surface electromagnetic wave. The interference periodically modulates the absorbed laser energy across the irradiated surface that results in modulation of the material removal from the surface. This type of LIPSS is produced by localized laser ablation that generates the periodic structure by etching the surface. However, there is a different kind of LIPSS produced by modification of material of the initial surface, referred to as oxidative LIPSS because it typically leads to the oxidation of the surface rather than material ablation. Traditionally, the oxidative LIPSS are exclusively obtained on metals and metal films, and its formation is described by semiphenomenological models. Here, we report formation of the oxidative LIPSS on <100> surface of p-type Si crystals accompanied by ablation topography. For such purpose we used a commercial laser system Pharos P20. The laser delivers 266 fs pulses at a central wavelength of 1030 nm with average power up to 20 W. Characteristics of the obtained patterns suggests a specific microscopic mechanism of localized surface oxidation resulted from the generation of free carriers, electron photo-emission, and formation of local positively charged centers that support adhesion of oxygen from air. He novel ablative-oxidative periodic nanostructures have huge potential in different fields and applications since they allow tuning of surface properties not only through surface topography but also through chemistry.

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O.S.I.4.

Defect engineering and opening of the ion tracks in the swift heavy ion irradiated thin films of bismuth vanadate: Impact on oxygen evolution reaction for solar water splitting

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Swift heavy ion (SHI) irradiation using 150 MeV Xe ions (5×10^9 to 5×10^{11} ions cm^{-2}) was applied to engineer defects in hydrothermally synthesized $BiVO_4$ (BVO) thin films and analyze its impact on photoelectrochemical (PEC) performance toward the oxygen evolution reaction (OER). Exposure to SHI induces residual stress and amorphization, accompanied by bismuth-rich hillocks forming above oxygen-depleted ion tracks. At high fluence (5×10^{11} ions cm^{-2}), excessive defect accumulation and overlapping tracks lead to irreversible PEC degradation. In contrast, lower fluences (5×10^9 and 10^{10} ions cm^{-2}) generate moderate defects that initially trap charge carriers but subsequently enhance performance, resulting in photocurrent density increase of 58.6 and 25.2 %, respectively. Post-PEC analysis reveals that latent ion tracks evolve into nanoscale holes, with diameters up to 30 nm and depths up to 200 nm. Notably, the 10^{10} ions cm^{-2} sample exhibits well-defined holes, suggesting an optimal defect–stress balance that facilitates localized restructuring. This study provides new insights into SHI-induced modifications in BVO and demonstrates the potential of ion beam irradiation for nanoscale morpho-structural engineering. The controlled formation of nanoscale holes opens opportunities for incorporating cocatalysts or plasmonic structures to further enhance PEC activity.

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O.S.I.5.

Highly Efficient Hydrogen Evolution Using Ultra-Low Platinum Loading in CaO-Based Electrocatalysts

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The development of cost-effective and efficient electrocatalysts for the hydrogen evolution reaction (HER) remains a significant challenge, primarily due to the reliance on platinum-based materials. This study presents a novel approach for enhancing HER performance by incorporating a trace amount of commercial Pt/C (0.2 wt.%) into calcium oxide (CaO), a stable, environmentally friendly and abundant support material. The Pt/C-doped CaO composite was synthesized using a solvent-based method and thoroughly characterized electrochemically. Linear sweep voltammetry revealed a substantial reduction in overpotential from 637.4 mV for pristine CaO to 99.7 mV for the Pt/C-doped CaO, indicating a strong synergistic effect between Pt and CaO. Tafel analysis showed a significant improvement in reaction kinetics, with the composite achieving a slope of 127 mV dec^{-1} compared to 391 mV dec^{-1} for pure CaO. Electrochemical impedance spectroscopy further confirmed enhanced charge transfer properties, with a notable decrease in charge transfer resistance. These results demonstrate that even minimal platinum loading can lead to remarkable catalytic activity, offering a promising strategy for designing low-cost, high-performance HER electrocatalysts.

O.S.I.6.

Nearly percolated silver films for tailoring infrared losses: a morphology-based approach

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For operation in the infrared (IR) region, lossy materials are essential for applications such as thermal regulation, optical sensing, and energy management [1]. IR devices based on conventional interferntial multilayers may have thickness so high to cause mechanical failure of the system. Lossy materials successfully replace thick multilayers but they have limited tunability and complex fabrication requirements [2]. An emerging alternative is metal thin films near the percolation threshold where metallic domains are partially connected. These systems exhibit IR absorption due to their unique geometry and intermediate electronic properties [3]. However, fabricating such films with morphology control remains a challenge. Deposition of limited metal quantity or thermal dewetting of compact metal layer provide quite limited control of pore size, connectivity, and film uniformity [4]. This work proposes thermal annealing as a post-deposition method for tuning morphology of silver thin films deposited on TiO_2-coated soda-lime glass. The annealing of such systems enables morphological evolution of the metal film via ion exchange where silver from the top layer and sodium from the substrate diffuse into TiO_2 layer [5,6]. Varying the temperature and time of annealing provides a platform for tailoring optical loss in the IR region, rather than relying solely on deposition parameters or material choice. This approach offers a versatile method for developing nanostructured optical coatings operable in wider IR range.

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O.S.I.7.

PDMS-based magnetic nanocomposites: effect of magnetic nanoparticles on viscosity and wettability

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The integration of magnetic nanoparticles (MNPs) into polymer matrices leads to the formation of magnetic nanocomposites (PMNCs), which combine the magnetic properties of MNPs with the flexibility of polymers [1]. These multifunctional materials are suitable for a wide range of applications, including biomedicine, environmental remediation, electronic devices, sensors, drug delivery [2]. In this study, we investigate 10 nm oleic acid (OA) coated $CoFe_2O_4$ (CFO@OA) embedded in a poly(dimethylsiloxane) (PDMS) matrix. CFO MNPs were synthesized via co-precipitation method then functionalized with OA to improve their dispersion in PDMS. Fourier Transform Infrared Spectroscopy (FTIR), and Thermogravimetric Analysis (TGA) were used to determine the presence and the percentage of the organic coating. In addition, Dynamic Light Scattering (DLS) measurements revealed that CFO@OA is stable in the used solvent. PMNC was obtained by the electrospinning technique in order to obtain fibrous morphology. CFO@OA showed a similar saturation magnetization value (80 emu/g at 5 K) to bulk value, indicating that the coating does not change the magnetic properties of CFO particles. Interestingly, after electrospinnig process a significant decrease the Ms value is observed. The presence of of 2.5 % CFO@OA nanoparticles within PDMS leads to an increase in its viscosit, (*i.e.* high viscosity level was obtained just after 48 h insted of 72 h). Moreover, the contact angle measurements under applied magnetic field (12 mT), show a decrease in hydrophobicity comapared to pure PDMS.

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O.S.I.8.

Correlative Spectromicroscopy of Platinum-Based Catalysts on 2D Materials: from Fabrication to Catalytic Activity

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Due to their reduced dimensionality, two-dimensional (2D) materials demonstrate unique properties. These materials have attracted significant attention in catalysis because of their high surface area and excellent activity. While graphene has been extensively studied, non-carbon 2D materials, such as transition metal dichalcogenides (TMDs), and monoelemental layered materials, also show great potential in catalytic applications. Recent studies have shown 2D materials as effective support for metal catalysts, where metal-support interactions can significantly enhance catalytic performance. Platinum (Pt) is among the most effective catalytic materials. However, its high cost requires strategies that maximize efficiency while minimizing usage. One approach involves depositing Pt nanoparticles (NPs) onto support materials to improve dispersion and boost catalytic activity. Strong Pt-support interactions have been shown to substantially influence performance. Nevertheless, achieving highly dispersed and stable Pt NPs remains a challenge. Although strong metal-support interactions can mitigate these issues, controlling the size and distribution of Pt NPs is essential for optimal performance.

This work aims to utilize chemical deposition to fabricate Pt NPs on 2D materials – specifically hydrogenated germananes and silicanes, MoS_2, and WS_2 – and to investigate the role of Pt-support interactions in catalytic activity. A correlative spectro-microscopy approach was used to characterize the obtained Pt-based catalysts. Energy-dispersive X-ray spectroscopy confirmed the chemical composition, while transmission electron microscopy and atomic force microscopy revealed the distribution, size, and height of the supported NPs. Additionally, Raman spectroscopy was done to understand the bonding between the Pt NPs and 2D supports. The catalytic activity and selectivity of Pt-based catalysts were studied using cinnamaldehyde selective hydrogenation as a model reaction. Our findings emphasize the influence of the supports' electronic properties on Pt-support interactions and, consiquently, on catalytic performance.

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O.S.I.9.

Application of Ion Beam Irradiation for Engineering of Graphene Oxide-Based Environmental Sensors

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Graphene oxide (GO) plays a significant role in scientific research due to its versatile surface chemistry and 2D structure. The adaptability of material makes it ideal for applications in sensors and energy storage. The structure and degree of oxidation of GO are closely linked to its electrical properties. Ion beam irradiation can selectively modify the oxidation degree of GO by removing oxygen-containing groups, depending on the beam energy and type. This process also introduces controlled defects into GO that tailor its electronic, mechanical, and surface characteristics. However, it is crucial to find a balance, or a 'sweet spot', where sufficient reduction enhances conductivity while preserving the integrity of the sp^2 carbon network. In this work GO, GO/12-tungstophoshoric acid and GO/cobalt-ferrite thin films were deposited on interdigitated electrode arrays (IDE) and irradiated with carbon ion beams of 2 MeV energies and fluences from 10^{13} to 10^{15} ions/cm^2. The electric properties of pristine and irradiated samples were investigated with electrochemical impedance spectroscopy method and correlated to oxidation degree obtained by X-ray photoelectron spectroscopy and structural properties obtained by Raman spectroscopy. The results outline the positive effect of ion beam irradiation on electric properties of all samples, where increased reduction of GO with increasing fluence lead to lower impedance values. Electric properties of obtained samples were tested in various environmental conditions to test the applicability in sensor devices.

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O.S.I.10.

Effect of Hydrogen Uptake on the Structural and Mechanical Performance of Ti-6Al-4V and Ti-0.3Mo-0.8Ni Alloys

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Adaptation of infrastructure to the current challenges of hydrogen utilization remains a significant, unsolved issue for metallic materials. The degradation of mechanical properties of alloys is associated with the interaction of hydrogen through its absorption and uptake into the crystal structure. In this study, a gaseous hydrogenation process was applied under defined pressure (150 bar) and temperature (600 °C) conditions. In order to determine the level of hydrogen absorption, thermal desorption spectrometry (TDS) was used. A key objective was to establish the hydrogen concentration at which saturation occurs, corresponding to the amount of hydrogen trapped in so-called hydrogen traps. Mechanical testing is conducted in conjunction with acoustic emission (AE), which allows to monitore changes induced by hydrogen concentration in the material. The degradation detected through this method, supported by fractographic analysis revealing changes in fracture morphology, offers insight into the nature of hydrogen embrittlement as a function of hydrogen concentration in the material.

O.S.I.11.

Advancing Protein-Based Biomaterials for Enhanced Wound Healing and Angiogenesis

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The skin acts as a frontline defense, shielding the body from harmful microorganisms and environmental toxins. Biomaterials designed to mimic extracellular matrix (ECM) offer promising strategies to accelerate tissue regeneration by modulating cellular behavior and ECM remodeling. This study investigates collagen-based 3D porous scaffolds prepared by a freeze-drying method, modified with additional biopolymers and chemically crosslinked using carbodiimide reagents to enhance mechanical and hydrolytic stability as well as bioactivity. To address the vascularization challenges in chronic wounds, different concentrations of a pro-angiogenic bioactive substance were incorporated into the scaffolds, aiming to stimulate neovascularization and improve healing outcomes. Scaffold morphology and pore structure were characterized via scanning electron microscopy. The release profile of the bioactive compound was analyzed using UV-VIS spectroscopy. Biocompatibility was evaluated through *in vitro* cytotoxicity tests on fibroblast cultures, and angiogenic potential was further assessed *in ovo* using the chick chorioallantoic membrane (CAM) assay. This comprehensive approach not only emphasizes the potential of protein-based biomaterials in wound healing but also highlights the importance of tailored scaffold design for promoting effective tissue regeneration.

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O.S.I.12.

Surface Effect in Spinel Iron Oxide Hollow Nanoparticles

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Magnetic nanoparticles (MNPs) have been extensively studied over the past few decades due to their unique magnetic properties, which are strongly influenced by finite size effects and, more prominently, by surface effects resulting from their high surface-to-volume ratio (R = S/V). The synthesis of spherical hollow magnetic nanoparticles takes this a step further, significantly enhancing the R. with a consequent increase of the disorder and magnetic frustration, thus opening new perspectives to explore the surface magnetism at the nanoscale. Here we present a comparative study of the morpho-structural and magnetic properties of full and different size hollow maghemite (γ-Fe_2O_3) nanoparticles, characterized by a big surface to volume ratio, of corresponding sizes 5.0(5), 7.4(7) and 13(1) nm respectively. These systems have been thoroughly characterized by means of DC magnetization measurement and in field ^{57}Fe Mössbauer spectrometry. The in-field hyperfine structure analysis suggested the presence of non-collinear structure for hollow NPs originated from the increased surface role due to the hollow morphology. Interestingly, an exchange bias effect was noted in the hollow structures, which is demonstrated by the recorded shifted M(H) hysteresis loop curve after field cooling [1]. Monte Carlo (MC) simulations on assemblies of ferrimagnetic hollow nanoparticles unambiguously corroborate the critical role of the surface. MC simulation results show that the spins in the external thicker surface and at the interface of the hollow particle are strongly exchange coupled.

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O.S.II.13.

Stretchable fabric-based flat hydrogels from woven fabrics

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Stretchable fabric-based flat hydrogels are fabricated from woven fabric using different fiber materials within the precursor fabric structure. At least one of the phases must be a water-soluble polymer fiber with a high amount of hydrophilic groups that tend to crosslink in order to obtain a proper hydrogel structure. Polyvinyl alcohol (PVA) is a polymer structure that contains a large number of hydroxyl groups, is water-soluble, and can be cross-linked by binding molecules with many chemicals of different properties.[1-3] PVA is a polymer that can be converted into a fiber structure, and yarns and fabric structures can be obtained from the resulting fibers. While a direct fabric structure can be obtained by using PVA fibers. PVA fibers can also be transferred to the fabric structure by blending them with other fibers with different properties, such as cotton for enhanced mechanical strength, polyester for durability, or spandex for elasticity, or by creating hybrid form yarns. When the resulting fabric structure comes into contact with solutions containing crosslinkers, the PVA molecules in the structure can simultaneously dissolve and crosslink, turning into a hydrogel structure.[3-5] Since hydrogelation occurs within the fabric structure, hydrogel structures can be obtained in surface form. In this presentation, we will introduce the preparation and characterization of stretchable, fabric-based flat hydrogels developed from woven textiles, which are conceptually linked to our previously published study on high-strength and stretchable fabric-reinforced hydrogel composites.[5]

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O.S.II.14.

Gel polymer electrolytes for supercapacitor application

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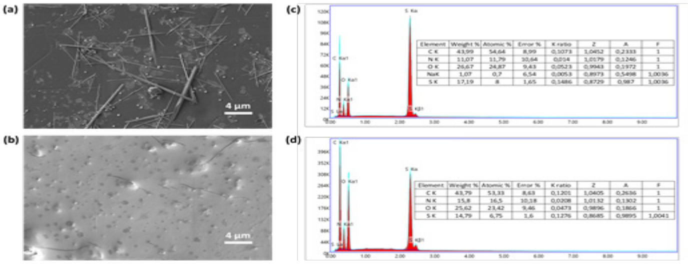
Energy storage systems have consistently played a vital role in societal progress and technological advancement. Among the promising solutions to meet current energy demands are supercapacitors, known for their high capacitance, high power density, and reasonably good energy density. Based on the type of electrode material used, supercapacitors are generally categorized into two main types: pseudocapacitors and electrochemical double-layer capacitors (EDLCs). Another key component of supercapacitors is the electrolyte. Traditional liquid electrolytes often pose challenges such as leakage, safety concerns, and low ionic conductivity. To overcome these issues, polymer electrolytes have garnered growing interest in both research and industry over the past two decades [1-2]. Their potential use extends beyond solid-state lithium or lithium-ion batteries to other electrochemical applications like supercapacitors, electrochromic devices, and sensors. In this study, a hydrophilic ionic liquid, 1-ethyl-3-methylimidazolium hydrogen sulfate, was employed to prepare polymer films using polyvinyl alcohol as the host polymer using solution casting technique. These films were characterized and evaluated for their performance in supercapacitor applications.



Element	Weight %	Atomic %	Error %	K ratio	Z	A	F
C K	43,99	54,64	8,99	0,1073	1,0452	0,2333	1
N K	11,07	11,79	10,64	0,014	1,0179	0,1246	1
O K	26,67	24,87	9,43	0,0523	0,9943	0,1972	1
NaK	1,07	0,7	6,54	0,0053	0,8973	0,5498	1,0036
S K	17,19	8	1,65	0,1486	0,8729	0,987	1,0036

Element	Weight %	Atomic %	Error %	K ratio	Z	A	F
C K	43,79	53,33	8,63	0,1201	1,0405	0,2636	1
N K	15,8	16,5	10,18	0,0208	1,0132	0,1302	1
O K	25,62	23,42	9,46	0,0473	0,9896	0,1866	1
S K	14,79	6,75	1,6	0,1276	0,8685	0,9895	1,0041

Figure 1. SEM Image of the prepared polymer film

The morphological studies were performed using SEM and are shown in Fig. 1(a-b). As can be seen from the SEM image, when the polymer content is relatively higher, the granular structures were observed in the films confirming the crystal phase in the films. The electrochemical properties of the prepared ionogels were evaluated by measuring the ionic conductivity at room temperature and also by varying the temperature (from room temperature to 100 °C), the electrochemical potential/stability window, and finally studying the dielectric and modulus loss to understand the ion transport efficiency. The composition of 85:15 (Ionic Liquid: PVA) was optimized to provide good mechanical stability and ionic conductivity for its application in energy storage devices. The room temperature ionic conductivity of the optimized film was found to be of the order of 5.12×10^{-3} S cm^{-1}. The optimized film was incorporated with a MWCNT electrode in a two-electrode setup as a complete cell to evaluate its performance for a supercapacitor application. The cell was tested using ac impedance spectroscopy, galvanostatic charge discharge and cyclic voltammetry. The fabricated cell provided a capacitance of ~39.4 F g^{-1} with an energy density of 5.5 Wh kg^{-1} and a power density of 0.3 kW kg^{-1}.

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O.S.II.15.

Electrocaloric Effects in Bulk and Composite Ferroelectrics: Synergies of Experimental Insights and Machine Learning

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Electrocaloric (EC) materials, capable of exhibiting adiabatic temperature change (ΔTEC) under an external electric field, offer a solid-state alternative to conventional cooling technologies, especially in miniaturized and environmentally conscious applications. Among lead-free electroceramics, $Ba_xCa_{1-x}Zr_\gamma Ti_{1-\gamma}O_3$ (BCZT) stands out due to its compositional tunability and enhanced performance near morphotropic phase boundaries. For instance, lead-based systems like PMN-PT exhibit robust electrocaloric effects due to their high polarization, while lead-free alternatives such as PVDF/BCZT composites offer comparable performance with reduced environmental impact. Textured PMN-PT ceramics optimize phase transitions for enhanced electrocaloric efficiency. Our composites with 0-3 connectivity designs integrate ferroelectric fillers to improve thermal conductivity and scalability. One the significant finding is that the BCZT sample fabricated by sol-gel process exhibited the highest electrocaloric effect (ΔT of 2.5 K at 80 kV/cm and 50 °C). This enhanced performance is attributed to its complex microstructure and optimized phase transitions, demonstrating the impact of sol-gel processing. All results show that polar nanoregions and diffuseness in phase transitions directly influence electrocaloric performance, providing a deeper understanding of the structure-property relationships for high-field energy applications. Additionally, we have conducted a predictive study with machine learning for future step. These advancements enable compact, solid-state cooling systems with minimal carbon footprints, directly addressing the global demand for sustainable thermal management.

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O.S.II.16.

Electromagnetic wave shielding effectiveness of the cotton fabrics functionalized with rGO and rGO-$SmVO_4$

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Due to a high permanent magnetization and the stability of the permanent state, the samarium (Sm) based materials can be a potential novel class of electromagnetic shielding (EMI) materials [1]. In this work, the dispersions of graphene oxide (GO) reduced (rGO) by L-ascorbic acid (AA), and nanoparticles of samarium vanadate ($SmVO_4$) were used for the continuous dyeing of cotton fabrics into 20 layers. A Keysight P5008A vector network analyzer was used to investigate the electromagnetic wave shielding effectiveness (EMW SE) of the cotton fabrics functionalized with rGO and rGO-$SmVO_4$. Measurements were conducted with a microwave coaxial probing set-up in the 6.5 GHz - 40 GHz frequency range. Previous testing showed that cotton fabric cannot block the propagation of EMW in the 8-12 GHz range. In the 6.5 - 40 GHz range, EMI SE of both textiles is above 77%. An average EMI SE for cotton-rGO is 14.1±1.9 dB, and cotton-rGO-$SmVO_4$ is 14.7±2.0 dB. Results indicated that cotton functionalized with rGO showed outstanding shielding effectiveness in the wide frequency range. Furthermore, functionalization with magnetic rare-earth-based nanoparticles enhanced the ability of the fabric to block EMWs in the tested range.

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O.S.II.17.

From Sound to Secure Qubits: Acoustic Modulation of Single-Photon Sources

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Photons are ideal information carriers for quantum communication, with various internal degrees of freedom available for encoding qubits. While most current protocols rely on polarization encoding, this approach is susceptible to decoherence due to polarization mode dispersion in optical fibers, limiting its scalability over long distances. To overcome these limitations, we demonstrate progress toward time-bin qubit encoding by dynamically modulating the optical emission of single-photon sources using surface acoustic waves (SAWs). These acoustic waves are generated on piezoelectric $LiNbO_3$ substrates featuring delay lines, onto which GaN/InGaN core-shell nanowires hosting quantum-dot-like emitters have been mechanically transferred. The emitters, formed via indium composition fluctuations in the InGaN shell, exhibit strong linear polarization and photon antibunching, confirming their quantum nature through polarization-resolved micro-photoluminescence and photon correlation spectroscopy. Under SAW excitation at ~330 MHz, the excitonic transitions of these emitters are dynamically modulated via acousto-mechanical coupling, achieving spectral tuning over a ~2 meV range. Time-resolved stroboscopic measurements reveal oscillations in emission intensity that correlate with the SAW phase, attributed to simultaneous injection of photogenerated electrons and holes into the quantum dot. This differs from prior SAW-driven systems where sequential carrier injection dominates. Crucially, by spectrally filtering the SAW-tuned emission, we can map photon energies to distinct arrival times, enabling acoustic control of photon time-bin encoding. This method offers resilience against fiber-induced decoherence, making it well-suited for quantum key distribution and other secure communication protocols. Additionally, the presence of biexcitons points to the potential for on-chip entangled photon pair generation at elevated temperatures. These findings mark a step toward scalable, acoustically tunable photonic qubit sources based on III-nitride semiconductors for practical quantum information technologies.

O.S.II.18.

Search for a storage phosphor based on YAP for emerging applcations

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Accumulative phosphors are usually used in luminescent dosimetry of ionizing radiation, but one of the main requirements for them is the so-called tissue equivalence, which is determined by the proximity of the effective atomic number Z_{eff} of their composition to the living tissue of the human body ($Z_{eff} \approx 7.5$). The tissue equivalence of dosimetric phosphor ensures approximately the same course of all processes of interaction of radiation with matter and, accordingly, the proximity of the dose absorbed in the body and dosimetric material, regardless of the energy of radiation. For this reason, phosphors with high Z_{eff} values have been studied much less. On the other hand, it is precisely the significantly more intense absorption of radiation energy in the energy range where the photoelectric effect dominates that creates new opportunities for the use of phosphors with high Z_{eff} values – in X-ray imaging, and estimation of the radiation spectrum by the difference in the measured values of the absorbed dose. The latter task is important from the point of view of determining the quality of X-ray sources in medical diagnostics and therapy as well as for rapid recognition of an unknown radioactive source in the context of radiation terrorist attacks [1,2]. In this work, we report the results of the study of X-ray, photoluminescence, phosphorescence, and optically stimulated luminescence (OSL) of two materials based on yttrium-aluminum perovskite (YAP) $YAlO_3$, activated by Mn and Bi ions. The first one was firstly studied for thermoluminescence dosimetry and demonstrated its advantages determined by matrix properties. But attempts to use it by means of OSL method, which is much more advanced method of dosimetry today revealed that this material is much more preferable for applications as material for persistent luminescence [3]. Instead, YAP:Bi proved to be much more suitable for OSL dosimetry, while retaining all the previously identified advantages of the YAP matrix [4].

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O.S.II.19.

Cr^{3+}-Activated Ga$_2$O$_3$:In^{3+} as a NIR Source: Understanding Quenching via Photoelectric and Thermal Studies

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Cr^{3+}-activated luminescent materials have gained attention for biological applications, particularly as candidates for phosphor-converted NIR LEDs used in food quality and composition analysis. A major objective is to develop materials with efficient broadband NIR emission and to better understand quenching mechanisms such as state crossing and autoionization. Ga$_2$O$_3$ doped with Cr^{3+} exhibits strong NIR emission in the 650–900 nm range, peaking at 740 nm. Substituting Ga^{3+} with larger In^{3+} ions enables a red shift of the emission maximum to 850 nm. Excitation spectra reveal three UV-Vis bands: a broad band at 250–300 nm (attributed to band-to-band transitions, charge transfer, and Cr^{3+} $^4T_1$(4P) excitation) and two visible bands corresponding to Cr^{3+} transitions from $^4A_2$ to $^4T_2$ and $^4T_1$. Similar transitions appear in photoconductivity spectra, confirming the role of Cr^{3+} in photocurrent generation. Temperature-dependent measurements show that luminescence in Ga$_2$O$_3$:Cr^{3+} remains stable up to 400 K but quenches at higher temperatures. In In^{3+}-doped samples, luminescence intensity decreases at lower temperatures, as supported by decay time analysis. In contrast, photocurrent intensity increases with temperature, particularly in In^{3+}-modified samples, suggesting that thermal quenching is influenced by state crossing but by ionization. An innovative approach using photoelectric measurements provided new insight into luminescence quenching and its temperature dependence. This work challenges the prevailing assumption that thermal quenching occurs solely between states of the dopant itself. The findings reveal that quenching is instead linked to previously overlooked dopant ionization, which, unexpectedly, involves hole formation in the valence band rather than electron transfer to the conduction band. This discovery is crucial for designing and developing new optical materials with improved performance and broader application potential.

O.S.II.20.

Determination of Lateral Sizes of Graphene Oxide Nanosheets and Implications for the 2D/Oxides integration

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Accurate determination and control of lateral size of graphene oxide (GO) nanosheets is important for their application in various technologies. The present study combines spin-coating and scanning electron microscopy (SEM) to reliably determine the lateral dimensions of GO nanosheets. Our methodology leverages precise surface functionalization of silicon substrates with optimized silicon oxide thickness for contrast enhancement and reduction of common SEM issues like nanosheet overlap and poor substrate differentiation. Compared to traditional drop-casting or dip-coating methods, spin-coating offers improved nanosheet distribution control, minimal overlap, and higher throughput, thus facilitating consistent and efficient nanosheet characterization. The study also critically assesses the advantages and limitations of widely used characterization techniques, including Raman spectroscopy, TEM, dynamic light scattering, and AFM. The obtained results were also discussed from the perspective of 2D/oxide thin films integration. By addressing methodological particularities this research enhances the reliability and accuracy of GO nanosheet size determination, contributing to better integration of 2D materials with semiconductor technologies, as an essential step toward functional device applications.

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O.S.II.21.

Variation of filler size and concentration to optimize the dielectric properties of $SrTiO_3$/LDPE composites for energy storage applications

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As energy storage is an essential area of modern research, there is a growing demand for advanced materials that will improve efficiency and performance in this field. Polymer composites have proven to be very promising candidates for this application. In this research, we examined how the addition of strontium titanate ($SrTiO_3$) would affect the dielectric properties of low-density polyethylene (LDPE). Polymer composites and polymer nanocomposites with different filler concentrations were synthesized. To investigate the effects of different filler sizes and concentrations on the samples, UV-Vis spectroscopy was conducted. Based on the results of dielectric spectroscopy, it was found that the dielectric permittivity increases proportionally with the amount of incorporated filler. At the same concentration of $SrTiO_3$ for the composite and nanocomposite, the samples with nanoparticles had higher values of dielectric permittivity. The difference between these values becomes more pronounced with increasing filler concentration. To characterize the dielectric loss and energy dissipation in samples, the frequency dependence of the dielectric loss tangent was considered. Based on these results, an analysis was carried out to determine the optimal concentration of $SrTiO_3$ that provides high storage capacity and, on the other hand, low losses in composites and nanocomposites. When selecting the optimal sample for energy storage applications, conductivity values were also taken into account because they significantly affect the dielectric properties of the material.

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O.S.II.22.

Dry-spun carbon nanotube films as patternable and solvent-free counter electrodes for perovskite solar cells

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The CNTs were synthesized by chemical vapor deposition (CVD), and the resulting CNT films were directly transferred onto perovskite-based substrates without the need for binders or additional processing. The structural and surface properties of the CNT electrodes were characterized by water contact angle (WCA) measurements, Raman spectroscopy, four-point probe analysis, and scanning electron microscopy (SEM). In addition to their excellent conductivity and surface compatibility, the CNT films could be readily patterned using simple mechanical cutting techniques, enabling customized electrode designs without requiring high-vacuum processes. The CNT-based PSCs exhibited a power conversion efficiency (PCE) reaching approximately 80% of that obtained with conventional metal counter electrodes, demonstrating the feasibility of replacing metal components with pure CNT films. Notably, the dry-spun CNT films provide a scalable, patternable, and solvent-free fabrication route, highlighting their potential for roll-to-roll processing and large-area device integration. These results suggest that dry-spun CNT electrodes represent a promising alternative to conventional electrodes in next-generation perovskite photovoltaics.

O.S.II.23.

Enhanced Solar-Driven Hydrogen Evolution via C/N-Coated TiO_2 Nanoparticles Produced from $Ti_3C_2T_x$ MXene and gCN

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Photocatalysis offers a promising pathway for sustainable hydrogen production by directly harnessing solar energy, making it a clean and renewable alternative to fossil fuels. As global energy resources deplete, developing efficient photocatalytic systems is crucial for addressing energy supply instability and supporting the transition to a low-carbon future. In this study, $Ti_3C_2T_x$ MXene and graphitic carbon nitride (gCN) were used as precursors for synthesizing TiO_2 nanoparticles coated with a carbon/nitrogen shell (C/N@TiO_2), designed for hydrogen generation in photocatalytic process under simulated solar-light. The synthesis was achieved through a simple, one-step annealing process. The photocatalytic performance was optimized using two main strategies: (1) adjusting the precursor's ratio of MXene to gCN, annealed in air at 550 °C, and (2) fine-tuning the annealing temperature. The most efficient hydrogen evolution was observed with a precursor ratio of MXene:gCN = 1:19. The optimized C/N@TiO_2 sample (MXene:gCN = 1:19; 600 °C) achieved an outstanding hydrogen production rate of ~38 mmol/g, which is approximately 655 times higher than that of gCN (~57 μmol/g) and 37 times greater than that of TiO_2 derived from pristine MXene (~1024 μmol/g). This exceptional photocatalytic activity is attributed to the formation of the C/N shell, which significantly enhanced the stability of TiO_2 under the experimental conditions. The shell facilitated charge separation, suppressed electron-hole recombination, and improved visible light absorption.

O.S.II.24.

Composite materials for multifunctional applications

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In this communications, are reported two methods to prepare composites based on poly(vinyl chloride) (PVC) and carbon nanostructures of the type graphene oxide (GO) and single-walled carbon nanotubes (SWNTs) for applications as flame-retardant agent and membranes for management of pollutants of the dyes types. In the first case, the synthesis of PVC/GO composite involves a chemical reaction, at a temperature of 60 ^{0}C, of commercial PVC grains with hexyl ethyl cellulose and lauroyl peroxide at which are added GO sheets dispersed in dimethylformamide, in order to obtain PVC spheres coated with GO sheets. Raman scattering and FTIR spectroscopy studies have highlighted changes which indicate the appearance of ClCH=CH-, CH_2=CCl-, and/or -CH=CCl- units as a result of PVC partial dehydrogenation as well as new -COO- and C-OH bonds on the GO sheet surfaces [1]. The potential of PVC spheres coated with GO sheets as a flame-retardant agent will be highlighted using microscale combustion calorimetry (MCC) studies. In the second case, composites based on PVC and SWNTs decorated with TiO_2 nanoparticles were prepared using inversion method, in order to obtain membranes, for removal of rhodamine 6G (Rh6G) from wastewaters. The chemical interactions at the interface of PVC with SWNT and TiO_2 are highlighted by considering the Raman lines assigned to the vibrational mode E_{1g} of TiO_2, defects and tangential mode of SWNTs and the C-Cl bonds of PVC. Studies using UV-VIs spectroscopy have indicated an increase in photodegradation efficiency of Rh6G up to 85.1%, when membranes of PVC are activated with highly-separated semiconducting SWNTs decorated with TiO_2 nanoparticles.

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O.S.III.25.

Using superplastic forming and diffusion bonding technology for manufacturing aerospace products

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The structures in the form of thin-walled hollow panels and shells are widely used in aircraft, shipbuilding and a number of engineering structures. Studies conducted in recent decades abroad and in Russia show that high efficiency in the manufacture of multilayer hollow structures provides a technological process based on the combination of superplastic forming with diffusion bonding (SPF/DB). Multilayered structures obtained by the method of SPF/DB are called cellular, since they are thin-walled shells divided by integral partitions with them into a plurality of hollow cells. The SPF/DB method is currently considered to be one of the most promising because it provides flexibility to design and fabricate complex designs with a mass saving of up to 30 % while reducing the manufacturing cost by about 50%. The paper describes the results of long-term investigations on the development of technology of superplastic forming and diffusion bonding (SPF/DB) conducted at the Institute of Problems of Metal Superplasticity of the Russian Academy of Sciences (IMSP RAS). Different investigation techniques were developed and the effect of superplastic deformation on kinetics and the mechanism of solid-state joint formation have been revealed. Experimental technological processes for manufacturing typical products of aerospace engineering developed in IMSP RAS are described. The latest results and prospects for the development of technology SPF/DB are discussed.

O.S.III.26.

The method of Anomalous SAXS and its application to analyse the Structure and Composition of Nanomaterials

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The Small Angle X-ray Scattering (SAXS) is a non-destructive method for the analysis of nano-structures in a wide variety of nanostructured materials. This method allows determining average structural parameters on a length scale from just above the atomic size up to several 100 nanometers such as size distributions, volume fractions and inner surface sizes. Moreover, Anomalous Small Angle X-ray Scattering (ASAXS) exploits the anomalous dispersion of the scattering amplitudes near the X-ray absorption edges of elements that are contained in the sample. These element sensitive contrast variations are used to analyze averaged composition fluctuations on the nm scale. This talk will elaborate on the advantages of ASAXS in the analysis of complex multicomponent materials [1]. In the second part, different kinds of nanomaterials are chosen to illustrate different aspects, methods, and benefits of ASAXS in the fields of alloys, physisorption processes using Xenon and catalysis.

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O.S.III.27.

Functional mesostructures as tunable platforms for CO_2 Capture and Conversion

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Engineering materials through rational design remains a significant challenge in developing systems with predictable and optimizable properties based on structure–texture–morphology–activity relationships. Among the promising candidates, ordered mesostructured materials—such as mesoporous silica (OMS), ceria (OMC), and alumina (OMA)—offer unique advantages including synthetic versatility, chemical inertness, tunable particle size and porosity, ease of processing, and the ability to form well-ordered frameworks. Such features make these mesostructures ideal platforms for advanced composite materials tailored for applications in sorption and catalysis, particularly in sustainable energy and environmental technologies like carbon capture and utilization (CCU). Their ordered frameworks serve as scaffolds that enable the homogeneous dispersion of inorganic active phases in the form of highly reactive small and ultrasmall (<3 nm) nanoparticles, as well as organic molecules. The well-defined porosity ensures access for a wide range of reactants, while the mesoporous walls hamper sintering, enhancing durability and regenerability. By tuning the nature (amorphous or crystalline), composition (e.g., SiO_2, Al–SiO_2, CeO_2, TiO_2, $Ti_xZr_\gamma O_2$, Al_2O_3), and pore structure (hexagonal or cubic) of the mesostructure—and by incorporating active phases via tailored strategies—it is possible to design a broad variety of functional nanocomposites. This flexible approach enables the creation of highperformance materials for various applications, especially in CO_2 capture and catalytic conversion. This overview highlights our recent developments in CO_2 sorbents (e.g., NH_2-OMS) and catalysts for CO_2 conversion into valuable chemicals such as dimethyl ether (CuZn@Al-OMS, CuZnZr@Al-OMS), methane (Ni@OMS, Ni@CeO_2@OMS, Ni@CMS), and dimethyl carbonate (CeO_2-OMS). The integration of ultrasmall active nanoparticles with ordered mesostructured supports has proven highly effective for designing materials that are simultaneously active, stable, and regenerable. Additionally, the use of industrial waste as an alternative to commercial silicon precursors offers a promising route for cost-effective synthesis and large-scale implementation.

O.S.III.28.

SnO_2 nanofiber thick films for ethanol sensing: preparation, characterization, and performance

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In this study we report on ethanol sensing properties of tin oxide (SnO_2) thick films prepared from electrospun SnO_2 nanofibers. In the preparation process, polyvinylpyrrolidone (PVP) and tin (II) chloride dihydrate ($SnCl_2{\cdot}2H_2O$) were separately dissolved in a binary ethanol (EtOH) and dimethylformamide (DMF) solvent mixture. The electrospinning solution was prepared by mixing and stirring PVP and $SnCl_2{\cdot}2H_2O$ solutions at 45 °C. Under controlled electrospinning parameters and humidity (35-37% RH) the fibers were electrospun onto aluminum foil and subsequently calcined at 550 °C. The structural and morphological properties of the resulting SnO_2 nanofibers were characterized using X-ray diffraction (XRD), Brunauer–Emmett–Teller (BET) surface area analysis, scanning electron microscopy (SEM), and field emission scanning electron microscopy (FESEM). For thick film preparation, the calcined SnO_2 nanofibers were dispersed in terpineol and the obtained paste was screen-printed onto Al_2O_3 substrates pre-patterned with interdigitated electrodes and integrated microheaters. The printed film was heated at 160 °C for 1 hour to remove the organic binder and improve adhesion between the sensing layer and the substrate. The sensor was tested at various ethanol concentrations (100, 10, and 5 ppm) and across a range of humidity levels (0% to 70% RH). The results showed a significant decrease in sensor response, from 40.1 to 4.2, as ethanol concentration decreased. Additionally, minimal variation in the sensor response was observed as humidity levels increased from 30% to 70% RH, indicating the sensor's potential for reliable operation in practical applications.

O.S.III.29.

Mesoporous High-Entropy Spinel Oxide Thin Films for Electrocatalysis of the Oxygen Evolution Reaction

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With the introduction of high-entropy oxides (HEO) as a novel class of materials, unexpected and interesting properties have emerged. A HEO consists of five or more ions occupying a single crystallographic site and inducing a high degree of configurational disorder, which increases the entropic contribution to the Gibbs free energy of formation, thus stabilizing their crystallographic structure. Significant efforts have been devoted to the development of new HEO phases; however, the large majority of synthetic approaches are based on solid-state, rather than sol-gel chemistry allowing only the preparation of micrometer-sized, low-surface-area particles. Sol-gel chemistry requires precise control of reaction kinetics to form uniform structures, which is most likely the reason why the preparation of ordered mesoporous HEO thin films by the soft-templating and evaporation induced self-assembly (EISA) approach has not been reported yet. The presentation informs about sol-gel synthesis of (ordered) mesoporous $(CrMnFeCoNi)_3O_4$ [1] and $(CoNiCuZnMg)Fe_2O_4$ [2] high-entropy spinel oxides prepared by dip-coating and EISA process. A synthetic route was developed, utilizing the unique copolymer (poly(ethylene-co-butylene)-block-poly (ethylene oxide), known as KLE, in order to obtain periodically ordered and 15 to 18 nm sized mesopores within the high-entropy ferrite (HEF) framework.[2] The meso-structured HEF electrodes were found to be crack-free on the nano- and macroscale. Time-over-flight secondary ion mass spectrometry and electron microscopy verified a homogenous distribution of all elements within the structure. The fundamental impact of a nanoscale on the photoelectrochemical and electrocatalytic properties was investigated: mesoporous HEF applied as both n-type photoanode and oxygen evolution cocatalyst for solar water oxidation, showed near-metallic electric conductivity, which was related to an electron hopping mechanism induced by the interaction of 3d-states of the inserted transition metals, and was found to improve perfor mances. The photoresponse of HEF photoanodes was limited owing to severe surface recombination as evidenced by intensity-modulated photocurrent spectroscopy. The novel high-entropy nanostructures can be considered as interesting candidate for energy conversion applications.

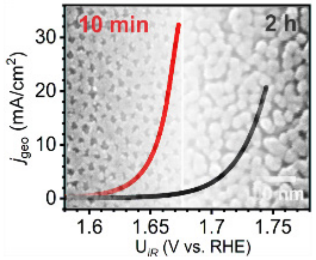

Figure 1. *Activity of mesoporous HEF thin films calcined at 600 °C for 10 min and 2 h and applied as electrocatalyst for driving the oxygen evolution reaction.*

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O.S.III.30.

Bridging structure and sensitivity: SnO_2 nanofibers for NO_2 sensing

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Industrial growth and vehicular emissions have worsened air pollution, contributing to global challenges like climate change and ecosystem disruption. Nitrogen dioxide (NO_2), primarily emitted from transportation and industrial processes, poses a significant health threat even at low concentrations (~30 ppb), highlighting the urgent need for sensitive, cost-effective NO_2 sensors. Semiconducting nanofibers, fabricated using electrospinning, are promising for enhancing gas sensing performance. Electrospinning controls nanofiber morphology, creating a highly porous and interconnected structure that increases surface area and improves gas diffusion, key factors for boosting sensor sensitivity and efficiency. This paper explores the fabrication of multi-porous tin dioxide (SnO_2) nanofibers via electrospinning and their application in detecting varying concentrations of NO_2. By fine-tuning the ratio of polyvinylpyrrolidone (PVP) to Sn-precursor, we achieved fibers with multiple pore channels, improving gas diffusion and surface reactivity. After electrospinning, the fibers were calcined at 550 ^{o}C to induce crystallization and pore development. Structural analysis revealed the formation of multi-porous fibers with diameters ranging from 30 to 130 nm, exhibiting a high surface area of 75 m^2/g, an average pore radius of 4.5 nm, and crystallite sizes of approximately 15 nm. The nanofibers were processed into thick films on Al_2O_3 substrates with interdigitated electrodes and microheaters via screen printing. The sensors, tested with controlled NO_2 concentrations, exhibited excellent sensitivity, quick response, and recovery times, showcasing their potential for sub-ppm NO_2 detection. This study emphasizes the effectiveness of electrospinning as a method for tailoring the structure and functionality of SnO_2 nanofibers, paving the way for next-generation NO_2 sensors for real-time environmental monitoring.

O.S.III.31.

Alginate-montmorillonite composites with effective sorption activity for cationic and anionic dyes and and heavy metal ions

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The research was focused on the development of hybrid organic-inorganic sorbents for the effective extraction of dyes and heavy metal ions from aqueous solutions. The design of the composites was based on the following requirements for their effectiveness: the sorbent should be effective at various concentrations of sorbate in solution, in a wide pH range, possess a high sorption capacity and pollutant removal percentage, and in line with modern sustainable development principles to be biosafe, thereby not contributing additional pollution to the environment.A series of alginate-montmorillonite composites (AMC) was synthesized based on low-cost natural raw materials. The sorption properties of the synthesized sorbents were determined for the cationic dye methylene blue (MB), the anionic dye congo red (CR) and cadmium ions (Cd^{2+}), which are among the most hazardous environmental pollutants. Due to the presence of carboxyl groups of sodium alginate and negatively charged active centers of montmorillonite in the AMC, they showed high sorption capacity for cationic pollutants (900 mg/g and 133 mg/g for MB and Cd^{2+}, respectively), as well as proved sorption ability for anionic CR (90 mg/g). The research results also demonstrate high values of the extraction efficiency of the studied pollutants by the synthesized composites, namely the removal of MB, CR and Cd^{2+} reached 99.8, 96.3 and 89.5%, respectively. Sorption kinetics studies revealed that AMC components adsorb dyes and Cd^{2+} *via* different mechanisms, and the montmorillonite presence in AMC is of key importance for the complete removal of MB dye at low equilibrium concentrations.

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O.S.III.32.

Decarbonized Titanium Recovery from bauxite residues

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Red mud is a by-product of alumina production, which is largely stored in landfills that can endanger the environment. Red mud, or bauxite residue, is a mixture of inorganic compounds of iron, aluminum, sodium, titanium, calcium and silicon mostly, as well as a large number of rare earth elements in small quantities. About 1.0 to 1.2 tons red mud is usually formed per ton of produced Al_2O_3 or approx. 400,000 t /year by company Alumina and about 20 million tons of this residue is deposited in Zvornik. This research underscores the potential of the using different decarbonized operations such as hydrogen reduction, high pressure and high temperature leaching, solvent extraction, aluminothermic reduction, ultrasonic spray pyrolysis and molten salt electrolysis as an efficient and scalable route for synthesizing metallic, oxide and composite powders from bauxite residues. The resulting oxidic powders of titanium oxides, characterized by their controlled properties and broad applicability, show significant advancements in oxide powder synthesis and resource-efficient manufacturing techniques. Our improvement in USP synthesis is focused on the continuous transport of aerosol from an ultrasonic generator to a high-temperature furnace, with powders collected efficiently using an electrostatic precipitator. This study explores USP-synthesis from titanium oxysulfate solutions derived from solid residues in aluminium industry, focusing on recovery of titanium and waste reduction via an initial hydrogen reduction of iron oxides from bauxite residues. The USP-experiments were performed at 1000 °C in oxygen atmosphere aiming at the synthesis of titanium oxides. The obtained titanium oxide powders are spherical with sizes below 1 μm.

O.S.III.33.

Engineered M13 Bacteriophage-Based Fabry-Pérot Etalon for Volatile Organic Compound Detection

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Recent advances in science and technology have improved the quality of human life but have also increased the risk of exposure to various harmful substances. To protect against these risks, extensive research is underway to develop diverse sensors. In particular, the importance of monitoring sensors for disease diagnosis, a process often requiring significant time and steps, has been continuously emphasized. However, conventional sensors face limitations in complex gaseous environments where multiple gases are present. In this study, we propose a colorimetric sensor based on the M13 bacteriophage that can operate effectively in complex and noisy environments with mixed gases. The photonic crystal-like self-assembly of M13 exhibits a structural color that changes upon exposure to gases. Furthermore, the amino acid sequence of receptors on the M13 surface can be manipulated through genetic engineering, enabling the detection of specific target substances. However, the broadening of the scattering spectrum caused by the M13 self-assembled structure leads to limitations in measurement precision, which is a critical issue to address for improving sensor performance. To overcome this limitation, we present a sensor with enhanced precision and sensitivity by integrating a Fabry–Pérot etalon and M13-based dynamic actuators. This measurement approach provides a simple and accurate method to evaluate the binding affinity and reactivity between M13 and target substances in the gas phase, and it can be applied to detect various target materials. We anticipate that these results will significantly expand the application potential of M13-based sensors.

O.S.III.34.

Comparative study of the photocathalytic activity of TiO_2&CeO_2&Ag and TiO_2&CeO_2&Pd nanocomposites in the destruction of organic dyes

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Today, semiconductor metal-oxide materials with high photocatalytic activity are in great demand, having found their application in the so-called "green technologies", particularly in the destruction of organic substances in aquatic environments and hydrogen generation. One promising approach to developing photocatalytic materials is the doping of metal oxides, such as titanium dioxide, with various other components, including noble metals and rare earth elements. While a substantial number of scientific studies focus on the synthesis and properties of binary composites based on titanium dioxide, there has been significantly less research on multicomponent systems based on TiO_2. This study aims to compare the photodegradation efficiency of organic dyes using ternary nanocomposites consisting of titanium dioxide modified with cerium and noble metals, specifically silver and palladium. The synthesis of the composites was conducted via the chemical method, using a titanium tetraisopropoxide solution as a titanium source. Solutions of doping salts were added to the system in a mass ratio of 0.5 to 3.5 wt%. The precipitates were heat-treated at 600 °C to obtain anatase structure. Solutions of rhodamine B (RhB), methylene blue (MB), malachite green (MG), methyl orange (MO), and orange G (OG) at a concentration of 20 mg/dm^3 were selected for photocatalytic studies. After the suspensions reached sorption-desorption equilibrium (30 min of stirring in the dark), they were irradiated by a portable Xe 15A lamp with a power of 300 W. The UV activity of the samples was studied in 5-130 min. The best results showed the samples with 1-2 wt.% of doping components, but when their content was raised to 3.5 wt.%, the efficiency of both systems was significantly smaller. Also, the degree of decolorization of MB solution in the presence of TiO_2&CeO_2&Ag reached 96 %, and in the presence of TiO_2&CeO_2&Pd it was 91%. The degree of decolorization of Rh B in the TiO2&CeO2&Ag system is 90.3 %, but in the TiO_2&CeO_2&Pd it decreased to 50.4 %. The highest degree of decolorization (99,9 %) was found for MG solution in the presence of TiO_2&CeO_2&Pd composites. The destruction of anionic dyes is lower and for OG in the presence of TiO_2&CeO_2&Ag it does not exceed 53.5 %, and in the presence of TiO_2&CeO_2&Pd - 41.1 %. The destruction of MO strongly depends on the pH values, and it is higher in neutral and weak alkaline media (yellow solution).

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Poster Presentations

P.S.1.

(4-Anisole)triphenyltin(IV) as a Potential Bioactive Agent: Synthesis, Characterisation and BSA Interaction Analysis

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Organotin(IV) compounds constitute a significant class of organometallic compounds known for their broad spectrum of biological activities [1]. Owing to their diverse mechanisms of action and promising results in both *in vitro* and *in vivo* models, these compounds have emerged as potential alternatives to conventional platinum-based anticancer agents [2]. In pursuit of more selective and efficacious anticancer agents, we report the synthesis and characterization of a novel aryltriphenyltin(IV) compound, (4-anisole)triphenyltin(IV), synthesized via a Grignard reaction involving triphenyltin(IV) chloride and 4-bromoanisole under an inert nitrogen atmosphere. The compound was characterized by multinuclear NMR spectroscopy (^{1}H, ^{13}C, and ^{119}Sn) and infrared (IR) spectroscopy, confirming the successful formation of the target complex. Elemental analysis further confirmed the compound's purity. The interaction of the complex with bovine serum albumin (BSA) was investigated using fluorescence quenching techniques, as BSA models drug transport and bioavailability. A concentration-dependent decrease in BSA fluorescence intensity indicated effective binding between the organotin complex and the protein. These results suggest that (4-anisole)triphenyltin(IV) compound demonstrates favorable protein-binding properties, supporting its potential as a candidate for further biomedical investigation and contributing to the expanding field of organotin(IV)-based therapeutic agents.

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P.S.2.

PLD-grown thin films of STO on silicon photocathodes for photoelectrochemical hydrogen evolution reaction

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Strontium titanate (STO) thin films epitaxially grown on silicon (Si) substrates act as both protective and electroactive layers in photoelectrochemical (PEC) water splitting. To investigate the influence of crystallinity and interface quality on hydrogen evolution reaction, ~10 nm-thick STO films were deposited *via* pulsed laser deposition (PLD) onto bare and reduced graphene oxide (rGO)-buffered Si substrates. The integration STO with Si was facilitated using SrO-assisted deoxidation and precise control the Si surface coverage with spin-coating of one to three graphene oxide layers (~50 - 100 % surface coverage). The STO films were grown at 515 and 700 °C, and characterized by reflection high-energy electron diffraction (RHEED), atomic force microscopy (AFM), scanning electron microscopy (SEM), X-ray diffraction (XRD), X-ray reflectivity (XRR), and X-ray photoelectron spectroscopy (XPS). AFM and XRR revealed smoother morphology and lower roughness for STO films grown on rGO-buffered Si. XRD showed that films grown at 700 °C developed a textured structure on both substrate types, while those grown at 515 °C on SrO/rGO-treated Si exhibited high crystallinity with strong (002) out-of-plane orientation. These results were supported by RHEED, which showed sharp streaks indicative the improved structural order on rGO-buffered substrates. Electrochemical measurements demonstrated that the epitaxial STO/rGO photocathodes had superior performance compared to non-epitaxial ones, with a lower onset potential (0.24 V *vs*. RHE) and a much higher photocurrent density (-28.78 mA cm^{-2}), with improved long-term stability as confirmed by chronoamperometry (CA). In contrast, non-epitaxial samples and those with silicate/silicide interfacial layers, particularly at 700 °C, exhibited reduced activity and stability, as shown by electrochemical impedance spectroscopy (EIS). These results highlight the critical role of interfacial design, crystalline orientation, and growth temperature in optimizing PEC performance.

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P.S.3.

Tuning of Persitent Luminescence and Thermoluminescence Performance of $LiGa_5O_8$:Cr^{3+} Spinel Modified by Addition of Aluminum and Indium

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Lithium-gallium spinel ($LiGa_5O_8$), when activated with Cr^{3+}, is a well-known phosphor with long-lasting persistent luminescence and mechanoluminescence in the deep red spectral region (around 700 nm). It is also known that the aluminum-based compound $LiAl_5O_8$ has the same type of structure, and a continuous series of solid solutions $Li(Ga_{1-x}Al_x)_5O_8$ exists, allowing a gradual change of the crystal structure parameters of these spinel compounds. At the same time, there is a lack of data on the possibility of introducing indium into $LiGa_5O_8$ or $LiAl_5O_8$ compounds and thus tuning the traps responsible for the thermoluminescence and mechanoluminescence properties of the materials. Therefore, the present work focuses on exploring the possibilities of the local and crystal structure engineering allowing to tune the persistent luminescence and thermoluminescence properties of $Li(Ga,Al,In)_5O_8$:Cr^{3+} phosphors. For this purpose, a series of $Li(Ga_{1-x-y}Al_xIn_y)_5O_8$:$Cr^{3+}$ compounds with different compositions (x values varying from 0 to 0.5 and y values varying from 0 to 0.1) have been synthesized by the solid state reaction method and characterized in detail by the powder XRD and luminescence techniques. The obtained results allowed to determine that the dissolution limits of indium in $LiGa_5O_8$ spinel are below 5%. However, even such a small value of In with respect to Ga allows to modulate substantially the depth of traps intrinsic to the spinel lattice. In such a way, the obtained results demonstrate that the modification of the $LiGa_5O_8$ host lattice by a partial substitution of Ga by Al and/or In has a high potential for tuning and improving the long-lasting persistent luminescence properties of the $LiGa_5O_8$-based phosphors.

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P.S.4.

Structural and electrochemical tuning of Ca-intercalated vanadium oxide for enhanced Ca-ion storage in aqueous half- and full-cells

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This study investigates calcium vanadium oxide (CaV_2O_6) as a cathode for aqueous calcium-ion batteries. CaV_2O_6 is synthesized *via* a malonic acid-assisted solution combustion method and is thermally treated at 400 and 700 °C. While both samples show limited Ca^{2+} storage ability, the low-temperature sample (CaVO400) becomes highly active when integrated with carbon. Electrochemical tests combined with *ex-situ* XRD, FTIR, and Raman, reveal that the initial Ca^{2+}/proton exchange forms a protonated $Ca_{1-x}V_2O_6$ phase enabling fast, reversible Ca^{2+} and H^+/H_3O^+ insertion. This process is further facilitated by $Ca_2V_2O_7$ by-product dissolution. As a result, the CaVO400/C composite delivers ≈ 87 mAh g^{-1} at 1 A g^{-1} in half- and ≈ 90 mAh g^{-1} over 100 cycles in full-cells [1].

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P.S.5.

GO-based nanocomposites with WPA and PTCDA for application in electrochemical supercapacitors

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Graphene oxide (GO) based nanocomposites, modified with 15 wt.% 12-tungstophosphoric acid and 3,4,9,10-perylenetetracarboxylic dianhydride, were investigated in this study to evaluate the effect of hydrothermal treatment at 180 °C for 1, 4, 8, and 12 hours on their potential for electrochemical energy storage. Structural and chemical changes were examined using FTIR, XPS, XRD, and temperature-programmed desorption (TPD), while morphological characteristics were studied *via* SEM and TEM. Prior HTT treatment, the FTIR revealed bands of major oxygen groups of GO and confirmed the incorporation of component incorporation. The XPS method has shown a reduction of oxygen-containing groups after HTT, with epoxides being dominantly removed. XRD showed changes in crystallinity and interlayer spacing. TPD method, beside desorption profiles of pristine GO and WPA, revealed significant increase of desorbed groups after HTT and corresponding changes in the TPD spectra. SEM analysis showed transformation of GO layered morphology into hierachically ordered porous structure after HTT. PTCDA was observed both on and within the GO and GO/WPA matrix, thus increasing microstructural complexity. TEM imaging revealed integration of PTCDA into GO matrix on the nanoscale, probably *via* π-π stacking and hydrogen bonding, while WPA formed nanostructured deposits on edges and basal plane of GO. After 8 hours of HTT, hierarchical structuring of the nanocomposites was evident and corresponded with improved electrochemical performance. Cyclic voltammetry revealed the highest specific capacitance of ~300 F/g for GO/PTCDA, attributed to enhanced surface functionality and morphostructural features. These findings support the further development of rational design of GO-based materials for advanced supercapacitor applications.

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P.S.6.

A Novel Co/Zn-Ferrite Molecularly Imprinted Polymer Sensor for Electrochemical Detection of Gallic Acid

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In this study, we present the development of a novel electrochemical sensor based on molecularly imprinted polymers (MIPs) for the selective and sensitive detection of gallic acid (GAL) in real samples, including plant extracts, wine, and herbal supplements. Gallic acid is widely recognized for its significant antioxidant properties and associated biological effects, such as anticancer, anti-inflammatory, and antimicrobial activities. To enhance the electrochemical performance of the sensor, cobalt-zinc-ferrite coated with dihydrocaffeic acid (CFO_Zn_DHCA) nanoparticles, characterized by their spherical morphology and an average particle size of 5±1 nm, were incorporated into the MIP matrix. The resulting GA/CFO_Zn_DHCA/3-APBA@MIP-GCE sensor exhibited a rough and porous morphology due to imprinting process, as examined using scanning electron microscopy (SEM). Electrochemical properties were investigated using cyclic voltammetry (CV), differential pulse voltammetry (DPV) and electrochemical impedance spectroscopy (EIS). The sensor exhibited a linear detection range of GAL from 10^{-13} to 10^{-12} M in a 5.0 mM $[Fe(CN)_6]^{3-}/^{4-}$ redox electrolyte, with calculated values of limit of detection (LOD) and limit of quantification (LOQ) of 1.29×10^{-14} and 4.29×10^{-14} M, respectively. The developed MIP-based electrochemical sensor demonstrated excellent performance in terms of sensitiviy, selectivity and reproducibility and was successfully applied for the detection of GAL in complex real-world matrices such as pomegranate peel, green and black tea, wine and various herbal supplements.

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P.S.7.

Electrochemically obtained tungsten oxide electrodes doped *in-situ* with chromium and manganese for photoelectrochemical applications

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Photoelectrochemical (PEC) water splitting has the potential to become a competitive method for hydrogen production, should it be based on inexpensive, efficient, and stable semiconductors [1]. Tungsten oxide is a promising material due to its good photostability and band gap energy sufficient to absorb visible light photons with a wavelength up to 480 nm. However, it is severely limited by low photoactivity within the visible light range, which can be overcome by WO_3 doping or by coupling it with other semiconductors [2]. In this study, WO_3 photoelectrodes were doped with chromium and manganese during electrochemical oxidation of tungsten foil, to enhance its photoactivity within the UV range and bathochromically shift its photoelectrochemical response. Anodization of tungsten was conducted in a water-based electrolyte containing 1 M $(NH_4)_2SO_4$ and 0,075 M NH_4F with differing concentrations of CrF_3 or MnF_2. The process was carried out at a constant voltage of 50 V for 4 hours. Samples were then annealed at 500 °C for 2 hours. The obtained WO_3 layer was characterized by SEM, EDS and XRD. Band gap energy and flat band potential of the materials were determined by DRS UV-Vis and Mott-Schottky analysis. Additionally, cyclic voltammetry was used to determine the electrochemically active surface area of obtained samples. The photoactivity of the materials was assessed under simulated sunlight as well as monochromatic light in the range of 300-600 nm. It was shown that modifying the samples using low concentrations of CrF_3 led to significantly improved photoelectrochemical activity when compared with unmodified samples. The proposed doping strategy for enhancing the PEC performance of WO_3 photoelectrodes is inexpensive and simple, making it a promising starting point for further research into the development of efficient and stable materials for PEC applications.

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P.S.8.

Adsorption of quercetin onto the two different types of nanomaterials that can be used as drug delivery materials

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The objective of this work was to investigate two different types of nanomaterials as potential drug delivery systems. The first is a naturally occurring mineral form of calcium apatite, known as hydroxyapatite (Hap), while the second is multi-walled carbon nanotubes (MWCNT), a carbon-based material. Drug delivery systems are utilized to effectively administer drugs to the body, ensuring controlled release, targeted delivery, and enhanced bioavailability. Hydroxyapatite was prepared using the wet precipitation method. The adsorption experiment was conducted with the flavonoid quercetin, chosen for its challenging bioavailability, attributed to factors such as low aqueous solubility, a short metabolic period, and toxicity. A quercetin solution was prepared in a mixture of water and ethanol (4:1) with a concentration of 10 ppm. The adsorption experiment was carried out over 24 hours with constant stirring at room temperature. The results were analyzed using a UV-VIS spectrophotometer at 370 nm. The findings indicated that 7.83 mg/g and 13.12 mg/g of quercetin were attached to the surface of hydroxyapatite and MWCNT, respectively. Docking calculations show that quercetin was bound to the surface of these materials through intermolecular interactions.

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P.S.9.

Green synthesis of polyphenol-derived nanoparticles from the branches of *Picea omorika* (Pančić) Purkyně and potential biomedical applications

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Polyphenolic compounds, with a particular focus on lignans, were extracted from the branches of *Picea omorika* (Pančić) Purkyně through an ethanol and water extraction. The lignans served as the basis for nanoparticle synthesis using ethylenediamine as a cross-linking agent during the hydrothermal process, while chemical synthesis was carried out using various amino acids as cross-linking agents. The synthesis of nanoparticles from *Picea omorika (Pančić) Purkyně* branches represents a sustainable alternative to conventional methods. The obtained nanoparticles were characterized using Dynamic Light Scattering (DLS) and Transmission Electron Microscopy (TEM), which revealed that the particle sizes were less than 200 nm. The particles also demonstrated moderate antioxidant activity against the DPPH radical, as determined by EPR spectroscopy. Special attention is given to their antimicrobial potential, which will be evaluated against selected microbial strains. As bioactive polyphenols, lignans possess inherent biological properties, including antioxidant and antimicrobial potential that may be enhanced or modulated at the nanoscale. These findings may support the development of novel nanoformulations for biomedical applications (*e.g.* wound dressings, drug delivery), food preservation, or environmentally friendly protective coatings.

P.S.10.

Improved electrochemical properties of niobium MXenes via addition of lanthanum for application in supercapacitors

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MXenes are the newest class of nanostructured two-dimensional materials, with tunable properties. In particular, niobium MXenes are characterized by high chemical stability during prolonged galvanostatic charge/discharge (GCD) cycles, high electrical conductivity and wettability with layered structure for ion transport, in addition to high surface area, and hydrophilicity [1]. The incorporation of other elements into their structure is an effective approach to increase the interlayer spacing, develops surface area and wettability by the electrolyte. This further improves the charge exchange [2] making MXenes advantageous for application energy storage devices, such as supercapacitors. In this work, the etching of Nb_4AlC_3 MAX phase with HF 40 % was performed, followed by delamination to a single-layer $Nb_4C_3T_x$. MXenes was subsequently doped with lanthanum (La) by mixing the MXene in 1 mol L^{-1} $La(NO_3)_3$ aqueous solution. The La-doped MXene ($Nb_4C_3T_xLa$) was electrochemically evaluated in a 2-electrode cell in 3 mol L^{-1} KOH. The addition of La to MXene increased the capacitance from 256 to 316 F g^{-1} at 5 mV s^{-1}. The GCD tests demonstrated that $Nb_4C_3T_xLa$ has higher capacitance (~66 F g^{-1}) and energy (9.17 Wh kg^{-1}) values compared to $Nb_4C_3T_x$ after 5,000 cycles. The incorporation of La has been demonstrated to enhance the electrochemical performance of MXene, thereby suggesting its potential application in supercapacitor devices.

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P.S.11.

Hybrid Polyaniline/rGO/AgNWs Composites for High-Performance EMI Shielding

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As electronic devices and wireless systems continue to expand rapidly, electromagnetic interference (EMI) has become a pressing issue, impacting both the functionality of electronic components and human well-being. Conductive polymer composites have gathered attention for EMI shielding due to their lightweight nature, mechanical flexibility, and ability to overcome the drawbacks of traditional metallic and carbon-based materials. Among the most promising fillers, reduced graphene oxide (rGO) and silver nanowires (AgNWs) stand out, offering high electrical conductivity, low percolation thresholds, and uniform dispersion within polymer matrices. In this study, novel polyaniline-based composite materials for electro-magnetic interference (EMI) shielding were developed by incorporating reduced graphene oxide (rGO), silver nanowires (AgNWs), and their hybrid (rGO/AgNWs) into a polymer matrix. To obtain flexible films with enhanced mechanical properties, the synthesized composites were incorporated into a polycaprolactone matrix. Morphology of prepared films was examined using scanning electron microscopy (SEM) with energy dispersive X-ray spectroscopy (EDX), while molecular structure was analyzed by FTIR and Raman spectroscopy. Electrical properties relevant to EMI shielding were evaluated using a Vector Network Analyzer (VNA). The PANI/rGO/AgNWs composite is anticipated to exhibit excellent EMI shielding performance due to uniform filler dispersion and the conductive pathways formed by metallic nanowires within the PANI matrix. This results in enhanced electrical conductivity and effective shielding, even at low filler content and minimal thickness, demonstrating strong potential for practical electromagnetic protection applications.

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P.S.12.

Eu-Y and Eu-13X zeolites as novel materials for Norfloxacin removal from wastewater

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Fluoroquinolones (FQs) are important class of synthetic antibiotics and their increasing presence in the aquatic environment is a significant cause of acute and chronic toxicity. In this study, norfloxacin (NOR) was selected as a representative of FQs because of its widespread consumption. Zeolites are crystalline aluminosilicates with uniformly sized micropores and they are known for their ability to exchange cations at specific sites within these pores. The main purpose of this work was to explore the application potential of Eu-exchanged zeolites Y and 13X for the removal of NOR from wastewater through adsorption and photodegradation during illumination with simulated solar light. The parent zeolites used in this study were the H-form of zeolite Y and the Na-form of zeolite X, both having the faujasite framework. Eu-Y and Eu-13X were obtained by an ion-exchange procedure using a dilute aqueous solution of europium nitrate. The prepared materials were characterized by X-ray diffraction, Fourier transform infrared spectroscopy, scanning electron microscopy with energy dispersive X-ray spectroscopy (EDS), low temperature nitrogen adsorption and fluorescence spectroscopy. EDS analysis showed that the europium content in Eu-Y was 2.6±0.7 wt.% and in Eu-13X it was 18.6±1.4 wt.%. NOR is a photosensitive drug that decomposes upon exposure to sunlight. Irradiation of NOR in aqueous solution led to a decomposition of 19 % after 3 h. In the presence of zeolite Y, the removal rate of NOR after 3 h was 74 % (56 % adsorbed and 18 % degraded) and for Eu-Y the removal rate was 60 % (28 % adsorbed and 32 % degraded). In the presence of zeolite 13X, the removal rate of NOR after 3 h was 67 % (28 % adsorbed and 39 % degraded) and for Eu-13X the removal rate was 73 % (46 % adsorbed and 27 % degraded). Thus, removal of investigated pollutant from aqueous solution was achieved through adsorption and photocatalytic degradation for Eu-Y and Eu-13X zeolites.

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P.S.13.

Mechanical and biological characterization of bone-like scaffolds with low and high alginate and calcium phosphate filler contents

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Three-dimensional (3D) cell culture systems provide physiologically relevant models that more closely imitate the cancer cell microenvironment compared to traditionally utilized cell monolayers due to 3D cell arrangement, introduction of extracellular matrix, and biophysical cues to the cells. In this study, we developed macroporous alginate scaffolds with hydroxyapatite/β-tricalcium phosphate fillers to simulate bone-mimicking microenvironment for 3D osteosarcoma cell cultures. Two scaffold groups were obtained from starting solutions: 1 wt.% Na-alginate, 1 wt% filler and 0.03 wt.% $CaCl_2$ (group G1) and 2 wt.% Na-alginate, 2 wt.% filler and 0.045 wt.% $CaCl_2$ (group G2). The short-term performance of these scaffolds was assessed by mechanical and biological characterization. Although the porosity of both scaffold groups was the same (60 %), G2 scaffolds exhibited enhanced dynamic stiffness and Young's compression moduli compared to G1 scaffolds, particularly after 7 days of cultivation under perfusion conditions (superficial medium velocity 40 μm/s). G1 and G2 scaffold biocompatibility was assessed in cultures of murine osteosarcoma cells K7M2-wt. First, the cell seeding procedure of the scaffolds was optimized, followed by cell cultivation in a perfusion bioreactor ("3D Perfuse", Innovation Center of the Faculty of Technology and Metallurgy, Belgrade, Serbia) under continuous medium flow for 7 days, with static cultures serving as controls. During short-term cultivation, the cells remained viable and exhibited higher metabolic activity under higher superficial velocity of the medium (40 *vs.* 15 μm/s). Moreover, following cultivation, the cells occupied scaffold pores in the form of coherent aggregates with a larger size under perfusion than under static conditions. Overall, both scaffold groups supported osteosarcoma cultures, with G2 scaffolds being mechanically superior to G1 scaffolds, potentially rendering them more suitable for long-term studies.

P.S.14.

Advancing osteosarcoma research: evaluation of a 3D osteosarcoma model for anticancer drug screening

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Despite comprehensive treatments, including surgery and chemotherapy, the prognosis for patients with osteosarcoma, the most common primary malignant bone tumor, remains unfavorable. One reason for this is the lack of relevant preclinical models that accurately mimic the complex tumor microenvironment. Modern three-dimensional (3D) *in vitro* models using biomimetic scaffolds, as cell carriers, and perfusion bioreactors, offer a promising approach to better study osteosarcoma biology and screen drugs. The aim of this work was to evaluate a previously developed 3D osteosarcoma cell culture model based on macroporous composite scaffolds combined with the "3D Perfuse" perfusion bioreactor (Innovation Center of the Faculty of Technology and Metallurgy, Belgrade, Serbia) for anticancer drug screening. Murine osteosarcoma cells (K7M2-wt) were seeded onto the scaffolds (2 wt.% alginate and 2 wt.% hydroxyapatite, 15×10^6 cells cm^{-3} scaffold volume) and cultured for one day under static conditions. Then, the cell-seeded scaffolds were cultivated in perfusion bioreactors at continuous medium superficial velocity of 40 $\mu m\ s^{-1}$ up to 10 days, and were treated with doxorubicin (1 $\mu g\ cm^{-3}$) following two regimes: i) a one-day treatment starting on day 1, targeting individual cells, and (ii) a three-day treatment starting on day 7, targeting spontaneously formed spheroid-like structures. The cell metabolic activity was assessed by the MTT assay, and morphology by histological analysis. The obtained results showed negligible effects of doxorubicin on individual cells as well as on cells within spheroid-like structures compared to the untreated 3D cultures indicating a resemblance to the chemotherapy resistance observed in patients. Overall, this work showed potential of developed 3D model based on alginate cell carriers and biomimetic perfusion bioreactor for short-term anticancer drug testing.

P.S.15.

Controlled Release of ADSC-Derived EVs from 3D-Printed PMMA-Gelatin Scaffolds for Bone Regeneration

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Bone tissue engineering aims to develop advanced biomaterials that support regeneration and enable targeted delivery of bioactive molecules. Extracellular vesicles (EVs), secreted by mesenchymal stem/stromal cells (MSCs), emerge as potent mediators of tissue repair. This study explores a novel 3D-printed scaffold system for the controlled release of EVs derived from rat adipose-derived stem cells (ADSCs). EVs circumvent many of the challenges associated with cell-based therapies, offering a safer, more stable, and easily controllable alternative for clinical applications. Their incorporation into structurally supportive and biodegradable scaffolds can enhance local retention, protect bioactivity, and improve regenerative efficacy at the defect site. Polymethyl methacrylate (PMMA)-gelatin scaffolds were fabricated using the mask-stereolithography 3D printing method and characterized in terms of printability, swelling behavior, mechanical properties and microstructure. The scaffolds were subsequently coated with a collagen-based hydrogel pre-loaded with ADSC-derived EVs. EV release kinetics were assessed in phosphate-buffered saline (PBS) at 37 °C over a 14-day period, with fluorescently labeled EVs quantified *via* nanoparticle tracking analysis (NTA).The results show that the composite system enables controlled and sustained EV release, supported by the hydrogel's retention capacity and scaffold's structural integrity. This dual-phase platform offers a promising approach for localized delivery of therapeutic EVs in bone tissue engineering applications.

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P.S.16.

Impact of Antimicrobial Composite Coatings on the Performance of 3D-Printed Macroporous Scaffolds for Bone Tissue Engineering

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Development of biomaterials that support cell adhesion, mechanical stability, local drug delivery, and antibacterial protection is essential in bone tissue engineering (BTE). To achieve antimicrobial effects at the implantation site, strategies such as ion-doping of inorganic particles or polymer coatings with antibiotics can be used. In bone tissue engineering, patient-specific macroporous scaffolds produced by 3D printing are particularly appealing. This study aimed to enhance the antimicrobial properties of 3D printed scaffolds through composite coatings composed of chitosan and mesoporous bioactive glass (MBG) particles doped with Sr^{2+}, Mg^{2+}, Cu^{2+}, and Zn^{2+} ions. Additionally, the coatings were evaluated as carriers for the antibiotic ciprofloxacin. Scaffolds based on poly(ethylene glycol) diacrylate (PEGDA), methacrylic acid, gelatin, and multi-doped MBG were fabricated by mask-stereolithography and coated with chitosan/MBG/ciprofloxacin coatings. Characterization included compressive strength testing, scanning electron microscopy (SEM), and antimicrobial activity against *Staphylococcus aureus*.

SEM confirmed effective coating, while preserving a connected porous structure with pore sizes of 500 to 900 μm. Ciprofloxacin-functionalized scaffolds exhibited strong antibacterial and antibiofilm activity, while MBG-containing coatings contributed both to enhanced compressive strength and additional antimicrobial effects. These results demonstrate that used coatings on 3D printed scaffolds represent a promising multifunctional system for bone regeneration and local infection control.

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P.S.17.

Microscale Tattooing of Hydrogels and Cells: Benzoxaborole-Driven Microcontact Printing of Glycosylated Surfaces

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Microcontact printing (µCP) is a widely used technique for microscale surface patterning. In this study, we present a polymer-supported µCP method for the patterning of (bioactive) glycosylated surfaces. This method was applied to three distinct surfaces: (1) monosaccharide-modified hydrogel surfaces prepared *via* a "grafting from" approach; (2) glycolsylated surfaces of polymeric microspheres; and (3) the membranes of human primary gastric cells. Specifically, we pattern aldose- (glucose, fucose, galactose) or ketose- (fructose, sorbose) functionalized surfaces. Patterning was achieved by direct contact with a patterned polydimethylsiloxane (PDMS) stamp, whose surface was grafted with a dopamine-containing polymer. The polymer brushes offer an anchor for the boronic acid derivative 6-aminobenzo[c][1,2]oxaborol-1(3H)-ol (ABOB), used as an ink for surface functionalization. During µCP, ABOB patterns transferred to the target surface through the formation of carbohydrate-ABOB complexes at neutral pH conditions. Fluorescence microscopy confirmed the successful transfer of ABOB patterns to glycosylated surfaces, with clear "tattoo-like" signatures observed on hydrogel and cell surfaces.

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P.S.18.

Synthesis of magnetic sorbents for removal of zinc ions using iron-containing wastewater

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The study explores the processing of exhausted etching solutions of electroplating facilities via ferritization method at different activations and aeration rates of the reaction mixture. The composition and structure of the obtained ferritization sediments were analyzed by X-ray diffractometry, revealing ferromagnetic crystalline phases of lepidocrocite (γ-FeOOH), ferrooxygite (δ-FeOOH), and chemically stable magnetite (Fe_3O_4). Scanning electron microscopy and X-ray fluorescence analysis confirmed the presence of highly dispersed particles and spherical aggregates in the sediments structure. Increasing the aeration rate and application of ultrasound enhances magnetite content and also iron ions removal efficiency from liquid waste. The possibility of using these materials as sorbents for heavy metal ions has been studied. The properties of the obtained sorbents for removal of Zn^{2+} ions were examined under the mechanical mixing and the influence of ultrasound at varying pH levels. The highest level of Zn^{2+} removal at pH 8 was achieved of value 92.0 % with sorbent containing of 61.3 % δ-FeOOH and 38.7 % Fe_3O_4 and application of ultrasound treatment. At pH = 10 the most stable magnetite-based sorbent ensured over 98.9 % Zn^{2+} removal, making treated water suitable for reuse in industrial rinsing processes. Analysis and compilation of the obtained data confirms the prospects of using effective and environmentally friendly magnetic sorbents for rinsing wastewater treatment of electroplating industries to remove heavy metal ions, in particular Zn^{2+}. The resulting sorbent is easily separated from the liquid phase on magnetic filters. Under formation conditions of stable solid phases of magnetite or zinc ferrite, the exhausted sorbent is suitable for further utilization, in particular, in construction materials capable of shielding electromagnetic radiation.

P.S.19.

Change in the Properties of 3D Printed Samples as a Function of Filament Density

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3D printing technology has been known since the eighties and is used in various industries. The principle and operation of 3D printing is easy to understand and implement, and for that reason it has a high use. 3D printing technologies are based on the principle of applying layers of material on top of each other. There are many other technologies. The most famous are divided into three categories according to the form of the printed material and the method of processing the given material. This contribution is devoted to 3D printing of a three-dimensional object from a digital 3D model. A spatial object is created by successive layering and joining. The FDM (Fused Deposition Modeling) method was used in the production of the samples. The filament that was used for 3D printing was PLA (polylactic acid). Different printing densities were chosen and their influence on the change of the mechanical properties of the samples. The choice of filler density has an impact on the production process, and the aim of this work is to document the effect of filler density on the properties of the samples using a tensile test. Knowing how to choose the appropriate level of infill density is an advantage in the process of manufacturing 3D printed products in terms of time and cost of production. Samples were printed with different values of filling density, and their mechanical properties were documented using a static tensile test. Measured test values were recorded numerically and the effect of density filling was compared between samples with different density.

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P.S.20.

Zn-Y zeolite photocatalytic oxide coatings on magnesium

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Metal oxide coatings containing Zn-species are prepared by conventional DC plasma electrolytic oxidation (PEO) of magnesium in water solution of sodium phosphate and potassium hydroxide, with addition of Y synthetic zeolite and zinc oxide. In addition, oxide coatings are made in the same supporting electrolyte with addition of solely Y or ZnO powder for comparison. Scanning electron microscopy equipped with energy dispersive X-ray spectroscopy, X-ray diffraction and photoluminescence measurements are employed to monitor the morphological, structural and chemical changes of obtained oxide coatings. It was found that chemical and phase composition strongly depend on PEO time. Photoluminescence measurements showed that clearly observable bands inherent to ZnO are present in the formed coatings. Photodegradation of methyl orange served as a tool to estimate the potential application of the obtained coatings. The study showed that addition of zeolites can improve photocatalytic properties of synthesized oxide coatings.

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P.S.21.

Formation of functional coatings on selective laser melting Ti6Al4V by gas nitriding

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Spinal disorders are among the leading causes of disability worldwide. Ti alloys, particularly Ti6Al4V, are widely used in spinal implants due to their favourable mechanical properties and excellent biocompatibility. However, major challenges such as stress shielding, insufficient osseointegration, and corrosion-related degradation persist. Additive manufacturing enables the fabrication of porous, bone-mimicking implants tailored to individual anatomy. Nonetheless, surface optimisation is required to improve implant integration and longevity. Among various surface engineering techniques, gas nitriding has demonstrated the potential to enhance both corrosion resistance and biological response. However, its application to 3D-printed Ti implants remains insufficiently studied. This study aims to investigate the effects of gas nitriding below the β-transus temperature on the surface properties of 3D-printed Ti6Al4V, with emphasis on corrosion resistance and biocompatibility. Ti6Al4V specimens were fabricated via selective laser melting and subsequently gas-nitrided at 700–800 °C for 5 to 10 h. Surface characterisation included SEM, EDS, and XRD. Nanoindentation was employed to evaluate hardness profiles across the diffusion layer. Electrochemical testing consisted of OCP and Tafel polarisation in Hank's solution. *In vitro* performance was assessed using an MTT assay to determine potential cytotoxic response. Results demonstrate that gas nitriding produces a functional nitride layer that reduces corrosion current density, with no negative impact on biocompatibility. These improvements suggest that gas nitriding is a promising strategy for extending the functional lifespan of 3D-printed Ti6Al4V spinal implants.

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P.S.22.

Zinc and manganese modified montmorillonite for anticorrosion applications in protective coatings on aluminium alloy

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Organic coatings with anti-corrosion pigments are used to protect metals from atmospheric corrosion. The most commonly used anti-corrosion pigments are strontium and zinc chromates. However, the high toxicity of chromates necessitates the development of new eco-friendly substitutes for anti-corrosion pigments. One alternative is ion exchange-type anti-corrosion pigments. A well-known natural ion exchanger is montmorillonite, which can be used for loading with corrosion inhibitors [1]. Montmorillonite is a silicate mineral that is a finely dispersed layered alumosilicate with a lamellar structure. Therefore, the aim of this study was to obtaine zinc and manganese loaded montmorillonite and evaluate the inhibitory effect on corrosion resistance of the AA2024 aluminium alloy. Montmorillonite from bentonite clay was obtained by the coarse-dispersed phase sedimentation method. The loading with manganese and zinc cations of montmorillonite was performed using the liquid phase ion exchange method. It was established that the corrosion resistance of aluminium alloy increases in an acid rain environment with zinc and manganese loaded montmorillonites after 3 and 168 h immersion. The inhibitory efficiency of the obtained montmorillonites increases in the following order: Mn loaded montmorillonite < Mn and Zn loaded montmorillonite < Zn loaded montmorillonite. The protective effect of zinc and manganese loaded montmorillonites is based on the release of divalent metal cations from the interlayer space of lamellar structure of montmorillonite, which interact with OH^- anions to form metal hydroxides on the cathodic areas of the AA2024 alloy. The formation of a protective film on the aluminium alloys surface in an acid rain environment with zinc and manganese loaded montmorillonites was confirmed by SEM and EDX analysis results.

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P.S.23.

Enhanced oxygen vacancy formation in Pt-WO_3 via W-OH bond cleavage using water-based one-step electrospinning for high-performance gas sensors

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Oxygen vacancies play a crucial role in charge transport and surface states in semiconductor metal oxides [1], significantly influencing various research fields, such as photocatalysis and gas sensor. Developing effective strategies to generate oxygen vacancy and thereby enhancing device performance is highly desirable. In terms of gas sensing, acetone stands out as a key indicator biomarker for diabetes which is one of the most critical health issues of the 21st century [2]. Therefore, it is essential and highly valuable to investigate the development and performance of materials capable of detecting low concentrations of acetone gas. In this work, we proposed a water-based one-step electrospinning method to introduce hydroxyl groups, leading to the synthesis of Pt-decorated WO_3 nanofibers (Pt-WO_3(H_2O)) with increased oxygen vacancies. The dissociation energy of W-OH is lower than that of W-O bonds, promoting the formation of oxygen vacancies via W-OH bond cleavage. These vacancies reduced the adsorption energy of acetone on the WO_3 surface, enhancing surface interactions. Consequently, the Pt-WO_3(H_2O) sensor exhibited an ultra-high response of 82 to 1.8 ppm acetone at 300 °C, which was about one order of magnitude higher than the one fabricated by conventional electrospinning. These findings indicate that water-based electrospinning is an effective technique for generating oxygen vacancy in metal oxide nanofibers. Our high-performance acetone sensor, capable of detecting low concentrations, holds great potential for applications in non-invasive health screening.

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P.S.24.

Enhancing Hydrogen Evolution: The Role of Rapid Thermal Treatment in Modifying MAX Structure

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As a large family of two-dimensional (2D) materials [1,2], MAX/MXenes have been widely used in many fields, including energy-related applications, either independently or integrated with other compounds [3]. Herein, Niobium Aluminum Carbide (Nb2AlC) MAX phase is subjected to a rapid thermal annealing (RTA) process under high vacuum conditions for controlled temperature and duration. The influence of RTA treatment on the structural and surface properties of MAX phase has been characterized by X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), Raman spectroscopy, High-Resolution Transmission Electron Microscopy (HRTEM), and X-ray Photoelectron Spectroscopy (XPS). Both MAX pristine and its thermally treated derivatives are examined for hydrogen evolution reaction (HER) performance using Linear Sweep Voltammetry (LSV), revealing the catalytic benefits driven by thermal processing. Ex-situ Raman and Impedance methods are employed to further examine the influence of RTA on the HER performance of the MAX phase. The work provides a simple and efficient approach for tuning the electrocatalytic properties of 2D materials.

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P.S.25.

Molten Salt-Assisted Synthesis of MXenes: Optimizing the MAX Phase Conversion

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MXenes are cutting-edge materials with diverse properties and applications, making them a hot topic in modern material research. Although the initial breakthrough in MXene synthesis was achieved using hydrofluoric acid (HF) [1], there is still a desire for alternative and greener synthesis methods [2]. This work presents an efficient and environmentally friendly method for synthesizing Ti_3C_2 MXene using molten salt synthesis. We will demonstrate how the transition from the Ti_3AlC_2 MAX phase to MXene can be optimized by adjusting the molar ratio of MAX to molten salt, as well as the reaction time and temperature. The impact of these parameters on the structure of the resulting material will be analyzed using X-ray powder diffraction (XRPD), Fourier transform infrared spectroscopy (FTIR), elemental analysis, and electrical conductivity measurements. This will demonstrate how the molten salt method can produce MXene materials that are suitable for energy-related applications.

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P.S.26.

Development of Copper–Silver Core–Shell Pastes for Heterojunction Silicon Solar Cells

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Copper–silver core–shell nanoparticles offer a cost-effective route to low-temperature metallization in silicon heterojunction (HJT) solar cells by combining economic advantage of copper with excellent conductivity of silver. Traditional silver pastes, despite their performance, result in high material costs and create challenges for large-scale production and commercial use. In this study, monodisperse copper cores are synthesized via wet chemical reduction and conformally coated with a thin silver shell through electroless plating to produce robust Cu@Ag architectures. These nanoparticles are formulated into a printable paste using an optimized blend of solvents, polymeric binders and curing agents. Comprehensive characterization is performed by transmission electron microscopy for shell-thickness uniformity, dynamic light scattering for colloidal stability and rheometry for viscoelastic behavior, under curing conditions below 200 °C. Printability on HJT solar cells and electrical performance, evaluated through contact-resistivity measurements, are compared against commercial silver pastes. The Cu@Ag formulation achieves metallization efficacy comparable to conventional silver pastes while significantly reducing silver usage. Our recent studies achieved a 20 % reduction in production cost, supporting scalable and cost-competitive HJT metallization.

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P.S.27.

Atomic-Level Insights into Cr^{3+} Doped $Cs_2Na/AgInCl_6$ Perovskites: ssNMR Probes of Paramagnetic Species Distribution and Pseudo Jahn-Teller Effect

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This study employs advanced solid-state nuclear magnetic resonance (ssNMR) spectroscopy to investigate local structural defects and electronic distortions (pseudo Jahn-Teller effects) in double-doped perovskite alloys $Cs_2Na_{1-x}Ag_xIn_{0.93}Cr_{0.07}Cl_6$. By the ^{133}Cs magic-angle spinning (MAS) NMR and ^{35}Cl WURST-QCPMG NMR techniques, we elucidate the atomic-level heterogeneity induced by Na^+/Ag^+ substitution and paramagnetic Cr^{3+} doping. ^{133}Cs MAS NMR experiments revealed a linear correlation between isotropic chemical shifts (114–122 ppm) and Ag^+ content, attributed to diamagnetic lattice modifications. The Cr^{3+} doping introduced symmetric line broadening (FWHM: from 75 Hz to 97 Hz) via pseudo-contact paramagnetic interactions, while multi-exponential T_1 ($1^{33}Cs$) relaxation analyses uncovered three distinct components: ultra-fast ($T_1 < 1$ s), intermediate ($T_1 = 35\text{-}74$ s), and slow ($T_1 = 100\text{-}700$ s). The dominance of the ultra-fast component in Ag-rich systems indicates Cr^{3+} homogenization into smaller domains, contrasting Na-rich systems where Cr^{3+} clusters form larger segregated regions.^{35}Cl WURST-QCPMG NMR resolved two crystallographic phases: phase A ($\delta_{iso} = 226$ ppm, $C_Q = 22.5$ MHz, $\eta_Q = 0$) corresponding to $Cs_2NaInCl_6$ and phase B ($\delta_{iso} = 253$ ppm, $C_Q = 26.7$ MHz, $\eta_Q = 0.01$) linked to $Cs_2AgInCl_6$. Signal integration revealed a nonlinear phase A/B ratio dependence on Na/Ag content. Ag-rich samples exhibited reduced signa-to-noise ratio (SNR) for Na-rich systems due to the "invisibility" of Cl^- atoms near Cr^{3+}ions, corroborating enhanced paramagnetic center dispersion. XRD-derived bond-length differences (In-Cl-Na: 5.257 Å vs. In-Cl-Ag: 5.240 Å) and pseudo Jahn-Teller distortions rationalize the observed structural motifs, where Ag^+ promotes lattice flexibility for Cr^{3+} incorporation. The synergy of $^{133}Cs/^{35}Cl$ ssNMR provides unprecedented insights into paramagnetic species distribution and local symmetry breaking in doped perovskites. These findings highlight the critical role of dopant chemistry in tailoring optoelectronic properties and demonstrate ssNMR spectroscopy as powerful tool in characterizing complexed double doped perovskites.

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P.S.28.

Integrated Surface Engineering Strategies to Improvement of Corrosion and Wear in Highly Porous Titanium

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This study examines the effectiveness of surface engineering methods—ball burnishing (BB), gaseous nitriding (GN) below the β-transus temperature, and their combination, referred to as deformation–diffusion treatment (DDT)—in enhancing the corrosion and wear resistance of highly porous titanium. Microstructural characterisation was performed using scanning electron microscopy (SEM), energy-dispersive X-ray spectroscopy (EDS), and X-ray diffraction (XRD). Micro- and nano-hardness profiles were also measured to evaluate the thickness and properties of the modified surface layers. Corrosion behaviour was assessed in a 20% HCl solution using potentiodynamic polarisation. Surface treatments led to a substantial reduction in corrosion current density, by a factor ranging from 8.7 to 25. Tribological performance was evaluated under boundary lubrication conditions in a tribo-pair with bronze. Subsurface porosity was identified as the primary factor contributing to delamination wear, due to fatigue-induced microcrack nucleation and propagation. Surface modification by BB, GN, and DDT significantly improved wear resistance and reduced the friction coefficient of the tribo-pairs by factors of 1.4, 3.5, and 4.0, and 1.8, 2.3, and 3.2, respectively. The DDT method, which integrates surface densification and nitride layer formation, produced the most effective improvement in both corrosion and wear resistance. These enhancements are attributed to a shift in the dominant degradation mechanisms and improved surface integrity. Consequently, the structural stability and service life of highly porous titanium are significantly extended. The proposed surface engineering strategy presents a practical approach for increasing the durability and reliability of titanium components operating in aggressive environments**.**

P.S.29.

Influence of precursor stoichiometry and mechanosynthesis modes on the hybrid organo-inorganic metal halide perovskite powders stability

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Due to their high absorption coefficient, metal halide perovskites have attracted considerable interest for various applications, such as photovoltaics, light-emitting diodes, laser diodes, and X-ray detectors. They have high optical constants, high carrier mobility, a large carrier diffusion range, and a unique ability to dynamically tune their band gap, which is critical for semiconductor applications [1]. The excellent optoelectronic properties of perovskites are comparable to those of traditional inorganic semiconductors such as GaAs, but they are relatively easy and much cheaper to synthesize. They can be processed using simpler deposition methods and at lower temperatures, making them attractive for mass production [2]. However, perovskite techniques are still relatively new, and there is significant scope for further research into the fundamental physics and chemistry surrounding perovskites. This work combines technology-oriented studies related to solution-free powder mechanosynthesis with magnetron sputtering of films to obtain stable hybrid organo-inorganic metal halide perovskites and investigations into the physical mechanisms underlying the exceptional properties of the studied systems and their tunability. Determining the role of precursor stoichiometry in the mechanosynthesis process, the influence of target preparation parameters, and sputtering details on the properties of the deposited films provide new insights into the stability and degradation processes of hybrid organo-inorganic perovskites. It is shown that the obtained powders can be used to produce perovskite films of high optoelectronic quality and stability for the rapid integration of such structures into modern solar cells.

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P.S.30.

Indirect Excitation of Rare-Earth Ions through Their Surroundings

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The rare-earth (RE) ions can be naturally excited through direct photon absorption at the corresponding energy matching the RE ion transition. The RE ions embedded in a matrix can also be, under particular conditions, excited via energy transfer from the excited matrix in its vicinity, *i.e.* indirectly, when the exciting radiation does not exactly correspond to the transition of the RE ion. This mechanism enables the excitation of RE ions over a wide range of wavelengths and allows the observation of their radiative transitions, which remain inactive in other materials under otherwise identical experimental conditions. The first condition that must be met is that the exciting radiation effectively excites the matrix itself. Another condition is that the matrix must be able to efficiently transfer energy to the embedded ion, and the ion must then release the acquired energy through a radiative process. We demonstrate this on materials with different phonon energy levels and absorption edge positions – on pure silica and tellurite glasses, both doped with RE ions – and we show that appropriately modifying the properties of the matrix (by doping with a *d*-element that suitably increases the photosensitivity of the matrix to exciting radiation), it is possible to enhance the efficiency of processes leading to photoluminescence from RE ions upon excitation through their surrounding matrix.

P.S.31.

Effects of Strong Electron Correlations and Nanoclusters Formation in Positron Spectroscopy of Disordered Alloys: Theoretical Model

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The development of modern science and technology is always based on the creation and development of new materials with unique properties. Currently, complex quantum systems with strong electron correlations (SECs), which determine the electronic properties of the system and its response to any external influences, are of the greatest interest. One of the most powerful methods allowing the experimental observation of the corresponding effects in the electronic structure is the method of positron spectroscopy, namely the angular correlation of electron-positron annihilation radiation (ACAR). Thus, the theoretical consideration of the effects of strong electron correlations and nanocluster formation on the momentum distributions of conduction electrons recorded by the ACAR method is important. We have developed a theoretical model for binary substitutional alloys with SECs in the Hubbard model (at temperature of 0 K). The above-mentioned effects significantly change the momentum distributions of electrons as well as the equilibrium values of density of charges and magnetic moments at atoms of different types (including nanoclusters) and the parameters of pair correlations in the arrangement of atoms of different types and in the orientation of magnetic moments at the nearest sites. Because of differences in the summation of the spectral function over reciprocal space and energy, the ACAR dependences often show greater sensitivity to the effects of nanocluster formation and electron correlations than corresponding electronic density of states dependences. Inaccuracies in the interpretation of experimental data from positron spectroscopy within the framework of the traditional free-electron model for this method are analysed.

P.S.32.

Blocking Oxygen Vacancy Migration in ZnO for Stable Perovskite Solar Cells: A DFT Study

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Zinc oxide (ZnO) is a promising alternative to the widely used indium tin oxide as a transparent conducting oxide, particularly in perovskite solar cells due to its high optical transparency and electron mobility. However, oxygen vacancies (V_O) in ZnO tend to migrate towards the perovskite interface, initiating degradation processes and reducing device stability. This work aims to suppress the migration of V_O by introducing structural disorder and impurity atoms into the ZnO lattice. To investigate this mechanism, we performed first-principles calculations based on density functional theory (DFT) using the PBE functional [1] and a Hubbard correction (DFT+U with U = 7.5 eV on Zn) with the Quantum ESPRESSO package [2]. The 2×2×2 pure and oxygen-deficient wurtzite ZnO supercells were fully relaxed. The self-consistent field (SCF), non-SCF, and density of states calculations were performed for both structures to examine the role of V_O. The method CI-NEB [3] within the DFT framework was used to estimate the diffusion energy barrier and the effect of interstitial Zn atoms on V_O diffusion in ZnO. The introduction of interstitial Zn atoms and impurities atoms of the boron group, which disorder and doper the system, can lead to efficient oxygen vacancies fixation without lowering ZnO optical and electrical properties and improve the long-term stability of perovskite devices with ZnO-based current-collecting interface.

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P.S.33.

Crystal structure design of new mixed $(Ga_{1-x-y}Al_xIn_y)_2O_3$ oxides

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Gallium oxide β-Ga_2O_3 with monoclinic structure is a well-known ultra-wide bandgap semiconductor that has attracted considerable interest due to its large bandgap of about 4.9 eV, a high breakdown field, and high thermal stability. These properties make β-Ga_2O_3 a promising material for a wide range of applications, including high-power electronic devices and solar-blind ultraviolet photodetectors. Simultaneous alloying of β-Ga_2O_3 with aluminum and indium oxides with the formation of ternary $(Ga_{1-x-y}Al_xIn_y)_2O_3$ solid solutions is an efficient route for tailoring the physical properties of gallium oxide based materials by modifying its crystal structure and energy band gap. In this study, series of mixed oxides with varying $Ga_2O_3/In_2O_3/Al_2O_3$ ratios were prepared by a facile solution combustion route. In order to estimate the existence range of the monoclinic β-Ga_2O_3 type phase in the ternary Ga_2O_3-Al_2O_3-In_2O_3 system, over twenty samples with different ratios of cations were analyzed. The main attention was paid to the compositional cross-section with a fixed x/y ratio of 0.69/0.31, which corresponds to the $(Ga_{1-x-y}Al_xIn_y)_2O_3$ series, in which the average cation radius remains equal to that of Ga^{3+}. It was revealed that single-phase material in the $(Ga_{1-x-y}Al_xIn_y)_2O_3$ series with a fixed x/y ratio of 0.69/0.31 is preserved up to a maximum $(x+y)$ value of 0.4. Crystal structure parameters of ternary solution were analyzed across a wide range of $Ga_{1-x-y}Al_xIn_y)_2O_3$ compositions, demonstrating the potential for purpose tuning of the β-Ga_2O_3 type monoclinic lattice. An empirical expressions relating the monoclinic lattice parameters of $(Ga_{1-x-y}Al_xIn_y)_2O_3$ materials to the average radius of constituent M^{3+} cations were established.

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P.S.34.

Influence of pre-deformation on mechanical properties and microstructure of EN-AW 7075 aluminium alloy

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This study investigates the changes in mechanical properties and microstructure of the EN-AW 7075 aluminum alloy after thermomechanical treatment. The treatment included cold plastic deformation, induced by rolling prior to artificial aging at a temperature of 150 °C for 30 minutes. The variations in hardness and impact toughness were monitored depending on the applied thermomechanical treatment conditions. Hardness was determined using the Leeb method, while impact toughness was measured using the Charpy method. The lowest hardness values were recorded in the annealed condition (Temper O state), while the highest impact toughness was observed in the quenched condition (Temper W state). The applied cold plastic deformation induced before artificial aging significantly increased the hardness of the investigated alloy, accompanied by a progressive decrease in impact toughness. Optical microscopy was used to analyze the microstructural changes during the thermomechanical treatment. Precipitates of various sizes and morphologies were observed in the alloy structure. The annealed condition was characterized by poorly defined grain boundaries and coarse secondary phase particles uniformly distributed within the matrix. Cold plastic deformation before aging resulted in a structure oriented in the rolling direction and refined secondary phase particles.

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P.S.35.

Modelling for H^{2+} ions in Ar/H_2 mixtures

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Understanding plasma distribution, characteristics, and phenomena is important for the development and optimization of plasma equipment for semiconductor device fabrication, such as etching and deposition tools. For this reason, plasma simulation is currently used in every phase of equipment design, development and improvement. It was found that the sets of cross sections obtained by applying the Denpoh-Nanbu theory to H^{2+} ions during Ar collisions are in general qualitative and partially quantitative agreement with the data from the literature. The Monte Carlo technique was used to calculate the transport parameters. The calculated cross-sections can be used to obtain transport coefficients, especially mean energy, reduced mobility and rate coefficients for low and moderately reduced electric fields E/N (E-electric field strength; N-gas density) and to calculate nonconservative collisions.

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P.S.36.

Possible smart materials based on compounds with valence unstable rare earth elements

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Intelligent materials occupy a special place among the huge number of known materials, and those that are being created all the time. Despite the impressive number of publications, no attempt has yet been made to classify compounds with a valence unstable rare earth element (R.E.) as smart materials. Our studies demonstrate that the value of the valence of the R.E. in some compounds can be changed by external and internal factors. The examples include the external pressure- or temperature-induced change in the valance value ($YbInAu_2$, $EuCu_2Si_2$), the dependence of the valence on the structural type of a compound ($YbNi_4In$ and $YbNiIn_4$), the dependence of the valence on the second component of ternary intermetallic compounds in $YbTCu_4$ (T = Au and Mg) and $Yb_2T_3Sn_5$ (T = Pt and Pd), the effect of d- and f-level occupancy on the valence state of Ce and Yb in compounds with the $ThMn_{12}$ structure (Ce and Yb in RM_4Al_8), the dependence of the valence on the occupation of d-levels. Changing the valance value of the R.E. may significantly alter the electrical and magnetic properties of compounds. Based on our studies and the review of a considerable number of research papers on the physics of compounds with intermediate valence, we argue that such compounds may be attributed to such a wide class of materials that are commonly referred to as intelligent materials. The most difficult part of creating intelligent materials and systems based on them is to provide feedback between the external impact and the object's response. Materials become intelligent when the sensing and actuating elements built on their basis are combined into an intelligent structure to achieve the required advanced functionality.

P.S.37.

Glycine-Nitrate Synthesis and Doping Effects on NFPP for Aqueous Sodium-Ion Batteries

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In recent years, developing materials with properties suited for large-scale applications, such as metal-ion batteries, has become a major challenge in materials science. Among promising candidates, mixed polyanionic compounds of the general formula $Na_4Fe_3(PO_4)_2P_2O_7$ (NFPP) have attracted considerable attention due to their favorable structural and electrochemical characteristics. It has recently been demonstrated that NFPP can be synthesized via a citric acid-assisted combustion method, yielding materials with theoretical specific capacity even at relatively high current densities [1, 2]. In this study, another type of combustion synthesis, the glycine-nitrate method was used, as it is known to be well-suited for the synthesis of fine, homogeneously dispersed, complex multifunctional compounds, making it a promising approach for preparing materials such as NFPP. The successful formation of NFPP was confirmed by X-ray diffraction and infrared spectroscopy. The electrochemical properties of NFPP were thoroughly investigated in an aqueous sodium salt solution at room temperature. Following this, the influence of a single dopant on both the structural integrity and electrochemical behavior of NFPP was systematically studied using the same characterization techniques. This approach allows a comprehensive understanding of how doping influences the material performance, potentially facilitating optimization for large-scale sodium-ion battery applications.

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P.S.38.

All-optical THz modulator based on MXene reflective structure

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The modulator of the terahertz (THz) waves is essential device for wave control in biological imaging, sensing, and next-generation communications. Despite active searches for materials for THz modulators among metamaterials, photonic crystals, 2D materials (mainly graphene), and metal oxides, a broadband THz modulator with satisfactory characteristics remains a challenge. MXenes were first synthesized in 2011 by Gogotsi *et al.* [1]. Due to superior metallic conductivity, highest among 2D materials, ultrafast carrier dynamics, high optical damage threshold, unique structure and as result tunable bandgap [2], MXenes have been widely used in electromagnetic shielding, filtering, different sensors, for energy storage, and so on [3]. In addition, MXenes are very promising materials for terahertz radiation modulators. The most attractive properties are such as high sensitivity to mechanical stresses, which makes it possible to create flexible modulators in a wide THz spectrum range [4], and the ability to control the phase matching of the impedance by using layered structures and, as result, to achieve the anti-reflection condition, or maximum reflection in the MXene layer [5]. We are currently working to enhance the performance of optically controllable THz modulators, focusing on optimizing their functionality in reflection geometry. The modulators are created by applying several layers of MXene directly to the surface of the semiconductor to ensure maximum reflectance from the structure. This approach was outlined in [5] and will substantially enhance the reflectance of the structure, thus providing enhanced modulation depth for the optical THz modulator. The optical properties, refractive indices, and extinction coefficients of the active MXene films, will be simulated by means of a first-principles approach over a broad frequency range.

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P.S.39.

Co-based soft magnetic amorphous wires for matching the wide bandgap-based devices

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The technological progress of soft magnetic materials is essential to attain high performance of the number of advanced magnetic devices. Co-based soft magnetic alloys are an important class of ferromagnetic materials, as their technological relevance stems from the combination of excellent permeability, and low core loss at high operating frequencies of wide bandgap-based devices which brings operation at higher temperatures, and potentially higher radiation tolerance. Co-based amorphous wires are promising candidates for advanced sensors and their emerging applications (smart mobile phones, biomagnetic field detection, IoT smart society, ...). This paper presents the properties of the magnetoimpedance (MI) elements of CoFeSiB and CoSiB amorphous wires, at the beginning of the intermediate frequency range (1 MHz $\leq f \leq$ 12 MHz), positioned in a longitudinal dc external magnetic field H_{ex}. The complex MI-modulus exhibits a constant increase of Z (H) with frequency, as well as the peak behavior observed, indicating the growth of the rotational magnetization contribution appearing above the domain wall relaxation frequency. These peaks of the MI-profiles are positioned at the anisotropy field H_k, suggesting the dominance of rotation magnetization in the circular permeability. A linear increase of the magnetic anisotropy field H_k is observed. The $(\Delta Z/Z)_{max}$ value of 384% for amorphous CoSiB wires was registered at a frequency of 1 MHz, while with a further increase in frequency, a constant decrease was recorded, as a result of the decrease in circular permeability. The Maximum MI-ratio of about 330 % has been registered for the frequency range $f \in$ [700 kHz, 1 MHz] for amorphous CoFeSiB wires. The frequency dependence of the MI-ratio with the magnetic field as a parameter exhibit the maximum value of 365 % (@1 MHz, 99 A/m) for amorphous CoSiB wires, confirming the reliable detection of weak magnetic fields.

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P.S.40.

Adenine to power: nitrogen-doped carbon nanofibers unlocking next-generation aqueous supercapacitors

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Supercapacitors are emerging as a cutting-edge solution in energy storage, offering a safer and more environmentally sustainable alternative to conventional devices. While traditional supercapacitor electrodes rely on pure carbon materials, recent advances have shown that introducing heteroatoms such as nitrogen, oxygen, boron, or fluorine through doping can significantly enhance performance. Nitrogen, in particular, has been shown to modify the electronic structure of carbon, boosting charge transfer rates and introducing additional pseudocapacitance. In this work, we present novel adenine-derived nitrogen-doped carbon nanofibers (NCNFs) designed specifically for high-performance aqueous supercapacitors. We systematically investigated how nitrogen functional groups influence energy storage efficiency in aqueous electrolytes. By adjusting the adenine content, we successfully tuned the nitrogen doping level, achieving up to 10.9% nitrogen as confirmed by X-ray photoelectron spectroscopy (XPS). The NCNFs delivered remarkable electrochemical performance, surpassing conventional carbon nanofibers. Cyclic voltammetry and galvanostatic charge–discharge measurements revealed specific capacitances of up to 180 F/g at 10 mV/s in 1 M KOH aqueous electrolyte. Swagelok cell tests demonstrated high capacitance values reaching 105 F/g. Notably, the electrodes exhibited nearly 100% capacitance retention over 2000 cycles, confirming their outstanding stability and suitability for long-term operation. The superior performance of these NCNFs arises from the synergistic interplay between high nitrogen content, optimized pore architecture, and enhanced electrical conductivity. Altogether, our findings position adenine-derived NCNFs as a highly promising material for next-generation aqueous supercapacitors.

P.S.41.

Expanding the MAX Phase: Discovery of a double A-Layer Ti_2Bi_2C MAX Phase

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MAX phases are a family of layered ceramics combining metallic and ceramic properties, known for their structural stability, conductivity, and mechanical resilience. In this work, we report the discovery of a novel MAX phase, Ti_2Bi_2C, which uniquely exhibits a double A-layer structure and the first to exhibit rhombohedral symmetry (R-3m), diverging from the conventional hexagonal symmetry typical of MAX phases. The phase was synthesized via a high-yield solid-state reaction using Ti:Bi:C in a 2:1:1 atomic ratio, sealed in vacuum to prevent Bi loss. X-ray diffraction, high resolution electron microscopy, and energy-dispersive spectroscopy confirm the formation of Ti_2Bi_2C with Bi-rich double layers and a nanolaminate morphology. Atomic-scale analysis reveals a consistent orientation relationship between the Bi precursor and the resulting MAX phase, suggesting that the A-layer atoms play a guiding role in the formation mechanism. Rietveld refinement demonstrates structural stability despite ~20 at.% Bi vacancies. This discovery not only expands the structural diversity of MAX phases but also highlights the potential of Bi-based systems for high-temperature radiation shielding, as the incorporation of bismuth, an element with a high atomic number ($Z = 83$) and strong X-ray attenuation capabilities, into a thermally stable, layered ceramic framework enables the design of materials that can withstand extreme environments while effectively attenuating ionizing radiation.

P.S.42.

Development of an electrically conductive coating for current collectors of lightweight high-temperature fuel cells

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Nowadays, high-temperature fuel cells, such as solid oxide fuel cells (SOFCs) and molten carbonate fuel cells (MCFCs), which at temperatures of 600-800 °C convert the chemical energy into electrical energy with an efficiency of 65 to 70 %, are used as means of alternative energy. Current collectors and bipolar plates, which provide the supply of the operating gas environment and current transportation in fuel cell stacks, serve as their multifunctional components. An interconnect determines the weight of the stack, which can reach hundreds of kilograms. Interconnect materials should possess high physical and mechanical characteristics, and oxidation resistance and electrical conductivity are among the most important ones. As materials for interconnects, highly alloyed steels with oxidation resistant and electrically conductive coatings based on spinels and perovskites are traditionally used. However, such interconnects lead to a significant weight of the stacks (the density of steel is 7.8 g/cm^3). We proposed replacing steel with titanium alloys and composites because of their low density (4.2 to 4.5 g/cm^3), which allows reducing the weight of fuel cell blocks by almost 2 times. It has been shown that these materials have high oxidation resistance but lose surface electrical conductivity during prolonged exposure in air at 600 °C. However, most studies on the oxidation resistance and electrical conductivity of composites based on MAX phases of titanium have been conducted in high-temperature air, and the results of their tests in a mixture of hydrogen and water vapour, which is more aggressive for titanium materials compared to air, are limited in the literature. The purpose of this work is to conduct a comparative analysis of the change in the characteristics of oxidation resistance and surface electrical conductivity during long-term exposure (1000 h) at 600 °C in air and a mixture of hydrogen and water vapour depending on the chemical and phase composition of the Ti-Al-Gd-N coating system as candidate materials for current collectors of lightweight high-temperature fuel cells.

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P.S.43.

The influence of iron and copper doping on the properties of anodic tungsten oxide layers

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The search for new materials used for photoelectrochemical water splitting to produce reduced hydrogen, the fuel of the future, is a growing research focus. Tungsten oxide (WO_3) is a promising candidate due to its suitable optical, physicochemical properties, low production cost, and high stability in aqueous solutions[1]. WO_3 has a band gap energy, of around 2.8 eV, making it an attractive material for photocatalytic applications. The presented method for obtaining this oxide in a nanostructural form is the electrochemical oxidation of tungsten foil. Depending on the chosen electrochemical synthesis conditions (e.g., electrolyte, voltage), it is possible to design its optical, semiconducting, and photoelectrochemical properties. Additionally, WO_3 obtained this way does not require further preparation, as it is directly formed on a conductive metallic substrate. To increase solar light absorption and improve the separation of photo-generated charge carriers, doping the nanolayers with transition metals, such as iron or copper, can be used. Moreover, thermal treatment of excess dopants can also facilitate p-n junction formation, further improving PEC performance.[2] In this study, Fe- and Cu-doped anodic WO_3 layers were synthesized via one-step electrolysis at 50 V in an electrolyte containing ammonium sulfate, ammonium fluoride, and iron(III) or copper(II) fluoride with varying concentrations (2 to 100 mM) for 0.5 - 4 hours. The effect of the precursor concentration and the electrochemical synthesis duration on the morphology, optical, semi-conducting, and photoelectrochemical properties of the materials was examined.

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P.S.44.

Thermal Conductivity Behavior for Some Characteristic Models of Nanostructures in High Tc Superconducting Ceramics

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We presented the results of the theoretical calculation of the thermodynamic properties of some characteristic model nanostructures (ultrathin films and superlattices), using the adapted method of two-time temperature Green's functions. Here, the coefficient of thermal conductivity was determined using the definitional connection with free energy, and then a comparison of their temperature dependence with the behavior of thermal conductivity of bulk structures was made. In the observed models of nanostructures, the values of the thermal conductivity coefficient are equal at low temperatures, but they are significantly lower than the values of the bulk sample. This result could be useful for the possible achievement of better superconducting conditions in the observed complex nanostructures that occur in high-temperature superconducting ceramics.

P.S.45.

The Acid Activated Metakaoline - Structural Analysis by ssNMR and FTIR Spectroscopy

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Acid (usually by phosphoric acid) activation of aluminosilicate precursors provides a new group of inorganic materials (acid-activated geopolymers) with promising chemical and thermal stability. These materials are prepared by polycondensation of a reactive aluminosilicate and phosphoric acid (or phosphate anion). Compared to alkali-activated geopolymers, they have high early strength, highly exothermic setting, high thermal and acid stability, neutral pH. The six mixtures were prepared in the metakaolin-phosphoric acid system, varying the Al/P molar ratio (0.8-4). ssNMR (Fig. 1) and FTIR were used for detailed structural analysis. Upon activation with phosphoric acid, the metakaolin system immediately undergoes a complex of large structural transformations. For example, this is documented by ^{27}Al MAS NMR spectra, which shows a clear evolution of two new resonances at ca. 50 and -13 ppm reflecting Al^{IV}-O-P and Al^{VI}-O-P units. Formation of these new alumino-phosphate entities is accompanied by a considerable consumption of original Al^{IV}, Al^{V} and Al^{VI} species of metakaolin, when at the highest P/Al ratio (1/0.8) only traces of the original Al^{IV}, and Al^{VI} units are detected, while the metastable Al^{V} species are completely consumed. Interestingly, also the amount Al^{IV}-O-P structural fragments, which are preferentially formed at lower P/Al ratio, when represent ca. 20% of Al units in the P/Al 1/4 system, is remarkably decreased going nearly to zero in the P/Al 1/0.8 system. We focused on the systematic study of the chemical structure, mineralogical composition and stability of the prepared acid-activated geopolymers.

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P.S.46.

Visible-Light-Activated CO_2 Photoreduction Over Ceria-Based High-Entropy Oxide Catalysts

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Up to this date, the development of highly efficient, visible–light–active catalysts remains a formidable challenge due to the enhanced rising of atmospheric CO_2 concentration. This study discusses a class of ceria-based high-entropy oxides, designed to optimize charge carrier dynamics, surface reactivity, and CO_2 activation efficiency. Due to the advantages of high configurational entropy and multi–element synergy, these materials achieved improved photocatalytic performance, surpassing conventional ceria-based systems. Structural and spectroscopic analyses reveal that Pr^{3+}/Pr^{4+} redox pairs and abundant oxygen vacancies create an electronically disordered yet thermodynamically stable environment, which enhances charge separation and suppresses electron–-recombination. Photocatalytic experiments demonstrated that $Ce_{0.2}Zr_{0.2}La_{0.2}Pr_{0.2}Sm_{0.2}O_{2-\delta}$ achieves the highest CO_2 conversion rate, reaching a conversion of 20.3 % under visible-light irradiation, significantly surpassing pure ceria (1.4 %), with a calculated STY of 10.15 $mol_{CO}\ kg^{-1}\ h^{-1}$ under the same conditions. First–principles density functional theory (DFT) simulations were employed to investigate the CO_2 reduction mechanism on CZLPS catalysts. The study elucidates the Gibbs free energy changes (ΔG) for each step of the reaction pathways leading to CO and HCOOH formation, highlighting the Zr site of CZLPS as the most active for CO_2RR, which is responsible for the outstanding catalytic activity.

P.S.47.

Microstructure evolution and tribo-mechanical properties of nano-multilayer TiMoN/NbN coatings

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Industrial cutting tools, such as blades and drill bits made from corrosion-resistant steel or hard metals, are widely used in automotive, aerospace, and woodworking sectors. The durability of these tools is compromised by harsh machining environments, which cause abrasive and corrosive wear. Thus, cutting tools are typically coated with micrometre coatings made from hard and refractory transition metal nitrides to improve the service life. While the performance advantages of employing hard mononitride coatings on cutting tools are well established, the performance mechanisms of multilayer coatings remain debated. Standard binary multilayer coatings have been extensively and deeply explored. A multilayer structure combining ternary and binary thin films has been created to improve mechanical properties further. In this matter, a multitude of metal nitride systems have been studied. However, we discovered a lack of research addressing the microstructure and mechanical properties, along with a detailed examination of multilayer TiMoN/NbN coatings. Considering this gap, the nano-multilayer TiMoN/NbN coatings have been synthesised for the first time using the cathodic arc deposition technique and are anticipated to serve as a potential protective surface layer for cutting tools. The scientific challenge was how to accurately construct the TiMoN/NbN coatings microstructure to achieve durable protective performance. Consequently, this research focused on characterising the multilayer TiMoN/NbN coatings produced by modulating the technological input parameters during deposition via cathodic arc evaporation. The evolution of the tribo-mechanical properties relative to microstructure, influenced by the alteration of deposition parameters, will be discussed.

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P.S.48.

Nanotubes/nanorods of KDP based on AAO matrices

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Matrix synthesis is a popular approach to obtaining nanomaterials due to its simplicity and low cost. As a matrix, anodised aluminium oxide (AAO) has several advantages: the ability to control the geometric parameters of the porous structure, periodicity and high porosity, cylindrical pore shape and high aspect ratio, AAO can be easily dissolved without damaging the nanostructures inside the pores. The process of incorporation of particles of metals, metal oxides, semiconductors, polymers or biological compounds into the pores and subsequent dissolution of the AAO substrate is one of the simplest methods for obtaining arrays of nanomaterials. The method of manufacturing nanotubes and nanorods consists in immersing the AAO nanomatrix in a prepared saturated aqueous solution of KH_2PO_4 (KDP) at a temperature of 55 °C, followed by controlled cooling to 50 °C, holding the matrix in the solution at 50 °C, and drying the formed AAO:KDP nanocrystalline structure at a temperature of 60 °C for 20 hours. By adjusting the time exposures of nanoporous AAO matrices in a saturated aqueous solution of KDP, it is possible to obtain crystalline compounds in the form of nanocolumns or nanotubes, which is confirmed by both X-ray and electron microscopy studies (Fig. 1). KDP nanotubes are formed at a holding time of 3 to 4.5 hours, and nanorods – at a holding time of 20-24 hours. Depending on the conditions selected, it is possible to achieve partial or complete filling of the pores, so the quantum dots and nanotubes/nanorods of various shapes and sizes can be obtained. Such structures can be used as an active medium in the optical range. Theoretical analysis has confirmed that the obtained array of nanorods reveals the properties of a photonic crystal.

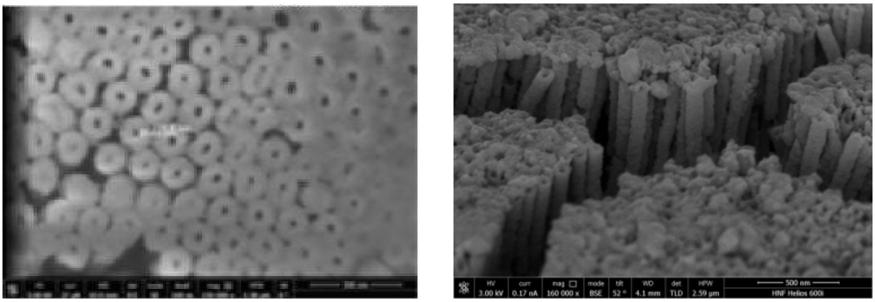

Figure. 1. *SEM images of nanotubes and nanorods.*

P.S.49.

Graphitic Carbon Nitride Modified with Aromatic Compounds for Enhanced Photocatalytic Cr(VI) Reduction

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Hexavalent chromium (Cr(VI)) has been identified as a prevalent contaminant in wastewater due to its extensive utilization in various industrial sectors. Photocatalytic technology helps clean wastewater that contains Cr(VI) by changing it into less toxic Cr(III). Traditional photocatalytic materials typically contain metal ions, and these ions may be released into water during the photocatalytic treatment of wastewater, resulting in secondary pollution. Graphitic carbon-nitride (g-C_3N_4) is a metal-free photocatalyst activated by visible light, which possesses many promising properties. However, this material faces the high recombination rate of the photogenerated electron-hole pairs. The unique π-conjugated electronic structure of this material is favourable for its hybridization with the aromatic compounds, which enhances the delocalization of the π-electron system in g-C_3N_4 to promote the separation of photogenerated charges. In this work, the possibility of increasing the photocatalytic efficiency of g-C_3N_4 by extending the π-conjugated system for the removal of Cr(VI) from water, was investigated. Facile thermal copolymerization between urea and 1,5-dihydroxynaphthalene and 2-amino-5-nitrothiazole with varying concentrations was conducted to obtain modified photocatalysts. The photocatalysts were characterized by FE-SEM, EDS, XRD, DRS, and FTIR. The photocatalytic reduction of Cr(VI) was investigated under simulated solar irradiation, at pH 3, with citric acid as a hole scavenger. Photocatalytic efficiency was slightly improved in all cases, regardless of the different aromatic structures and concentrations, indicating poor incorporation of the aromatic moiety in the structure, which is confirmed by the methods of characterization.

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P.S.50.

Casting Films from Cellulose Pulp and Office Paper Waste: A Sustainable Solution for Diverse Applications

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The widespread use and improper disposal of synthetic polymer films have raised growing environmental concerns. As part of the search for sustainable alternatives, cellulose films offer a promising solution for various products. This study explores the regeneration of cellulose from ionic liquid (IL) solution as a novel valorization route, with the potential to replace oil-based plastic films. Cellulose films were produced using both virgin cellulose pulp and waste of office paper, including electrophotographically printed (PCP) and unprinted (UNPCP) copy paper. The dissolution was carried out in 1-ethyl-3-methylimidazolium acetate ([EMIM][OAc]) IL, forming a homogeneous dope. The films were fabricated by rod casting onto a pre-heated glass plate, followed by regeneration using either 25/75 vol.% $EtOH/H_2O$ or methanol. Upon the film development, the residual IL was removed through washing in hot water. The testing of the sample mechanical properties revealed that the film made of cellulose pulp exhibited the highest breaking strain but the lowest modulus of elasticity. Incorporating 0.26 wt.% $CaCO_3$ (in an 80/20 Cell/PCP blend) enhanced the film's tensile strength. Notably, the PCP-derived film showed the highest modulus of elasticity among all samples. The influence of different regeneration bath on the film appearance, opacity and mechanical properties revealed that the highest modulus of elasticity is observed for sample 80/20 Cell/UPCP regenerated in $EtOH/H_2O$, while the highest tensile strength was observed for sample 80/20 Cell/UPCP regenerated in MeOH.

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P.S.51.

Cu and Ag Deposited on Pristine and Plasma-Treated g-C_3N_4: Noble vs. Non-Noble Metal Photocatalysts for Cr(VI) Reduction

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Photocatalytic reduction using semiconductors offers a cost-effective, sustainable way to remove toxic Cr(VI) from industrial effluents. Graphitic carbon nitride (g-C_3N_4, CN) is a promising option due to its chemical stability, facile synthesis, and visible light activation enabled by its moderate band gap (2.7 eV). However, its photocatalytic efficiency is limited by high carrier recombination and low utilization of visible light. The combination of CN with metal nanoparticles (NPs) forms metal-semiconductor heterostructures (MS) that enhance charge separation via the Schottky barrier and improve visible light absorption via the localized surface plasmon resonance (SPR) effect. The effective creation of MS heterostructures requires strong contact between CN and metal NPs. We assumed that plasma treatment, a widely used method to modify photocatalyst surfaces, could improve NP adhesion by introducing functional groups, altering morphology, and creating defects. The result would be enhanced stability and performance of CN-based heterostructures. This study explores the chemical reduction deposition of Ag and Cu on pristine and plasma-treated CN. Bulk CN was synthesized by thermal polymerization of urea, while $CuCl_2$ or $AgNO_3$ were used as NPs precursors. The properties of the photocatalysts were studied by XRD, FTIR, FESEM, EDS, TEM, PL and DRS analyses. Characterization revealed enhanced visible light absorption (DRS) and reduced carrier recombination (PL). A greater amount of Ag/Cu was deposited on the plasma-treated CN (EDS), with Ag-based samples showing superior and Cu-based samples showing lower photocatalytic performance compared to the pristine CN.

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P.S.52.

On Tesla-inspired Extended Quantum-Holographic Framework for Reprogramming Macro-Quantum Correlations of Individual and Collective Consciousness

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Nikola Tesla's visions and inventions realized in his controlled altered states of consciousness were considered previously as manifestations of his meditative insights within extended framework of quantum-holographic macroquantum correlations of individual & collective consciousness. This Tesla-inspired paper now focuses on some related psychosomatice aspects of quantum entropy & entanglement, and consequences on the usually observable biological arrow of time & spiritual-informational time reversal. Finally we discuss some spiritual-informational implications on free will & individual and collective consciousness reprogramming. Tesla's overall research can be an inspiration for reconsidering global educational/ /informational/political goals – with a reorientation to ecologically holistic subtle actions for solutions of the global risk society.

P.S.53.

Assessment of the distribution and origin of heavy metals in sediments of the Vrbas River (Bosnia and Herzegovina)

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The Vrbas River represents one of the most valuable ecosystems in Bosnia and Herzegovina. However, its quality has been significantly impacted by human activities. Many roads and settlements have been built along the river, and considerable sewage and agricultural wastewater flow. Additionally, the proximity of gas stations, industrial plants, and thermal power plants amplifies the anthropogenic impact. Heavy metals in river sediments can originate geologically through erosion, while many of these pollutants can originate from anthropogenic activities. This work aimed to assess the anthropogenic impact. Sediment samples were collected at 17 locations along the 250 km long river course during October and November 2021: five samples were taken in the upper part of the course from the source to the City of Banja Luka; five river sediment samples were taken from the city area itself, while seven samples were collected from the part of the course from Banja Luka to the confluence of the Vrbas into the Sava River. Samples were taken from the surface (to a depth of 10 cm) and prepared for XRF analysis by wet sieving. A fraction less than 63 µm was dried, mixed with paraffin, and pelleted. The anthropogenic impact on the concentration of heavy metals in sediments was estimated by pollution indices: geoaccumulation index, contamination factor, and potential ecological risk index.

P.S.54.

Biosafe and bioactive polysaccharide hydrogels with silver nanoparticles for enhancing crops vegetation and soil remediation

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A novel approach to design multifunctional, biocompatible, and bioactive hydrogel composites (HGCs) intended for potential application in sustainable agriculture was proposed. Due to alarming trends in soil pollution and degradation of agricultural land, there is an urgent need for so-called soil conditioners capable of improving soil health by addressing issues such as water retention and irrigation reduction, contaminant binding or removal, nutrient release facilitation, and prevention of bacterial and/or fungal crop diseases. A series of HGCs were synthesized based on alginate (Alg) and functional inorganic fillers, specifically laponite (Lap) and "green" silver nanoparticles (AgNPs). The HGCs demonstrated promising properties in terms of soil water retention: water-holding capacity increased 5.7-fold, and soil drying time extended 4.5-fold compared to native soil. Additionally, the HGCs showed high sorption capacity for Cd(II) (1.2 mmol/g) and pronounced bactericidal activity against key indicator strains (*E.coli*, *E.faecalis*, *S.aureus*, *P.aeruginosa*) and phytopathogenic *P.syringae*. The biocompatibility of the HGCs was confirmed using the comet assay and MTT test, which demonstrated the absence of genotoxicity and cytotoxicity, respectively. Furthermore, the HGCs exhibited bio-stimulatory effects on seed germination of watercress and maize. In the presence of Alg/Lap/AgNPs and Alg/AgNPs composites, increases in seedling and root lengths reached 43 % for watercress and 55 % for maize, compared to the control; the germination index (GI) was 100 %.

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P.S.55.

Design of porous zeolite-geopolymer membranes for efficient heavy metal removal from water

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Heavy metals are among the most prevalent and hazardous contaminants in water systems worldwide. Existing commercial solutions for heavy metal removal primarily rely on adsorption, microfiltration, and nanofiltration processes, utilizing powdered activated carbon or alumina ceramic membranes. This study introduces a novel membrane for water treatment, based on a zeolite-geopolymer composite, synthesized from environmentally friendly, abundant, and cost-effective materials. The core objective of this research is to integrate modified zeolite with a geopolymer matrix to develop a porous composite membrane with enhanced filtration capabilities and mechanical properties. Novel composites were prepared using low-temperature polymerization with NaOH as an activator. Different amounts of zeolite and metakaoline were used to obtain porous composites. Structural characteristics were determined by FT-IR and XRD methods, while SEM images showed microstructure with high porosity. Water adsorption measurements showed that samples had open porosity above 35 % while maintaining mechanical robustness and rigidness in water. By utilizing cost-effective and environmentally friendly materials, this study contributes to the development of sustainable filtration technologies, addressing global water contamination challenges.

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P.S.56.

Production of high-quality hydrochar and value-added liquids from biomass waste via wet torrefaction over zeolite catalysts

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Wet torrefaction (WT) is an efficient thermochemical pretreatment method for converting biomass waste into carbon-rich hydrochar and valuable liquid products under mild conditions. This study introduces a chemocatalytic WT strategy using zeolite catalysts (H-ZSM-5, H-Beta, H-Y, H-USY, and H-Mordenite) for upgrading wood cellulose pulp residue (WCPR), a lignocellulosic by-product from the pulp and paper industry [1]. WT experiments were conducted in stainless steel batch reactors (Parr 5000 System, 75 mL) under N_2, with pressure and temperature control [2]. Reactions were performed at 220 and 260 °C, with H_2O/WCPR = 10, for 15, 30, and 60 min. This system enabled simultaneous one-pot production of bio-ethanol and levulinic acid (LA), along with improved hydrochar quality. Ethanol selectivity reached 59.0 % using H-Y at 220 °C after 15 min, while the highest ethanol yield (75.6 %) was observed with H-USY at 260 °C after 60 min. Maximum LA selectivity (62.0 %) was obtained using H-ZSM-5 at 220 °C for 60 min [3]. Hydrochar produced with H-Mordenite (220 °C, 60 min) had the highest carbon content (71.5 %), a higher heating value of 27.3 MJ/kg, energy densification of 1.36, and carbon enrichment of 1.48. A reaction mechanism is proposed in which ethanol forms via cleavage of C–C bonds in hydroxyacetone, while LA results from cellulose hydrolysis to glucose, dehydration to 5-HMF, and rehydration [4]. These findings demonstrate the potential of zeolite-assisted WT as a route for integrated biofuel and biochemical production from lignocellulosic residues.

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P.S.57.

Reinforced Wood–Plastic Composites: Eco-Friendly Materials from Recycled Sources

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The increasing importance of sustainability and environmental protection worldwide has driven the development of innovative materials from recycled and renewable sources. In this context, wood-plastic composites (WPC) offer a promising solution by combining natural fibers and plastic waste into functional, durable building elements. In this study, the production of environmentally friendly WPC using mechanically shredded wood and waste polyethylene (WPE) is investigated to improve both ecological value and material performance. The production process involves two stages: In the first, the recycled components are mixed and extruded into briquettes; in the second, these briquettes are reinforced with three layers of metal mesh and hot-pressed to produce hybrid composites. These reinforcements contribute significantly to mechanical strength and durability and make the material suitable for demanding outdoor applications. Microstructural analysis using scanning electron microscopy (SEM) and chemical characterization using Fourier transform infrared spectroscopy (FTIR) confirm good interfacial bonding and material integrity. Mechanical tests, in particular impact and flexural strength measurements, indicate remarkable improvements in structural performance. In addition, all samples exhibited high moisture resistance even after prolonged exposure to water, emphasizing the long-term stability of the composite under real-world conditions. The use of recycled and waste-based materials not only minimizes environmental impact and reduces landfill but also extends the product life cycle in line with circular economy principles. These results support the wider use of WPCs in sustainable architecture and green infrastructure, while opening up avenues for further research into life cycle assessment, recyclability and industrial implementation.

P.S.58.

Development and In Vitro Evaluation of Starch–Gelatin Hydrogels for Potential Cartilage Repair

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The development of bioactive and affordable scaffolds for cartilage repair remains a key challenge in regenerative medicine. In this study, starch–gelatin (SG) hydrogels were fabricated via aqueous casting, lyophilization, and subsequent annealing, and evaluated in vitro alongside commercial references HyaloFast® and ChondroGide®. The resulting SG hydrogels exhibited a macroporous, highly interconnected structure with sufficient mechanical integrity for handling and implantation. Swelling behavior, mechanical properties, and degradation in PBS at 37 °C demonstrated balanced water uptake and gradual degradation, influenced by crosslinking parameters such as time and temperature. Human mesenchymal stromal cells (hMSCs) were seeded onto the hydrogels to assess cell retention and proliferation. A CTB assay on day one showed that SG hydrogels retained significantly more cells than ChondroGide® and comparably to HyaloFast®. Over 42 days, cell proliferation displayed an inverse relationship with initial retention, with SG hydrogels supporting moderate but sustained cell growth. Overall, SG hydrogels offer a promising combination of porosity, biodegradability, mechanical performance, and cytocompatibility. Their high cell retention and low-cost formulation position them as attractive candidates for scalable and accessible cartilage tissue engineering applications.

P.S.59.

Towards bio-inspired wound dressings: *Lactobacilli* targeting Gram-negative pathogens

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Diabetes mellitus includes a group of chronic metabolic disorders characterized by elevated blood glucose level or hyperglycemia. Among its most severe complications is the development of diabetic foot ulcers (DFUs), "hard-to-heal" wounds that are highly susceptible to infection which may lead to amputation, sepsis, or even death. The efficacy of conventional treatments, including systemic antibiotics and topical antimicrobials, is increasingly compromised by the rise of multidrug-resistant pathogens. Consequently, there is an urgent need for innovative and multi-targeted therapeutic strategies. In this context, probiotics have gained attention due to their intrinsic antimicrobial, anti-inflammatory, and immunomodulatory properties. The aim of this study was to develop and evaluate biocomposites composed of probiotic bacteria immobilized onto pads made of activated charcoal fabric. Initially, suitable probiotic strains were selected based on their inhibitory actiivity against a resistant *Pseudomonas aeruginosa* and *Klebsiella pneumoniae* isolated from patients wounds. All experiments were conducted under conditions mimicking the DFU microenvironment, using simulated wound fluid under microaerophilic and hyperglycemic conditions. Subsequently, the immobilization method was optimized to ensure the viability and long-term stability of selected strains on the pads. Imobilized probiotic cells were visualized using electron microscopy and their viability was assessed in normal saline solution (0.9 % w/v NaCl). Further experiments will evaluate the antimicrobial activity of these biocomposites against clinically relevant pathogens associated with chronic wounds, under conditions mimicking the hyperglycaemic wound environment.

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P.S.60.

Cellulose isolation from wild cyclamen (*Cyclamen purpurascens* Mill.) tubers

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Wild cyclamen (*Cyclamen purpurascens* Mill.) tubers are a source of various bioactive compounds, including saponins, tannins, alkaloids, and essential oils. Among the polysaccharides, starch and cellulose are the main components. This study aimed to evaluate the cellulose content in wild cyclamen tubers from southeastern Serbia (Predejane, Serbia, 42.83°N, 22.14°E) and to investigate its properties in order to propose potential applications. Cellulose was isolated using 4 and 18 wt.% sodium hydroxide (NaOH) solutions at a liquid-to-solid ratio of 10 mL/g, heated to approximately 70 °C for 3 h. Alkaline treatment was carried out at different concentrations to determine which is more suitable for the isolation of this biomaterial. NaOH is effective in degrading and dissolving other polysaccharides (such as lignin and hemicellulose), which are structural elements of cell walls, as well as in removing additional compounds. In this way, the purity of cellulose isolated from this plant material can be improved. The alkaline treatment was followed by bleaching the isolated cellulose using a 30 vol.% hydrogen peroxide solution. After filtration, the solid fraction was washed with distilled water and dried in a desiccator. The obtained cellulose was structurally characterized using Fourier Transform Infrared Spectroscopy (FTIR). Based on the observed hydration properties, the isolated biomaterial has potential as an ingredient in pharmaceutical products. Future studies will focus on further pharmaceutical and technological characterization of the cellulose powder.

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P.S.61.

Materials design for polymer films based on scaling principles and analogies with some bio-membranes

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It is well known that cell of many microorganisms, such as baker yeast, have walls supported by polymer networks. This allows them to change shape and volume on large scale and adduce to heat and dehydration stresses, as well. It has been often explained with hetero-polymer structure of those networks. But the high scaling of moduli can be achieved also with homo-polymers e.g. from poly(ethylene) can be produced films with lower and fibers with the highest moduli among common plastics. Obviously, some deeper structural reasons are responsible for so high scaling of properties. For instance, in yeasts these structures are primarily composed of mannoproteins, acting as soft segments, chitin as hard segments, and some linear glucans in between. To understand it better, we study how soft and hard segments with predefined sizes contribute to polyurethane properties, experimentally determined by one of us (ZSP) previously. Here we study poly(propylene-oxide)-diols (MW $2\text{-}3\cdot10^3$) and MDI, with radii of gyration R_g of 10-20 nm and density of 1.04 g/cm^3. By fitting the segment sizes to Flory's radii R_F and their changes under forces and using Flory's theory of elasticity, we calculated bulk, shear and Young's moduli in good agreement with experimental. The results also suggest appearance of a segment unfolding process from the coil shape of R_g size to more fibrous-like shape of much longer size. It can be understood in terms of de Gennes theory on rearranging possibilities of blobs building the R_F. A similar mechanism is likely to occur by cell wall network extensions. This offers a new approach to materials design, (either in predicting conditions or difficulties) of structuring by considering relaxation possibilities over Flory's radius and blob packing. Additionally, it can explain difficulties by PE chains alignment, by fiber drawing. In general, it shows how the correlation length ξ_{cor} of fundamental importance for Wilson's scaling theory "on renormalization groups", can be also applied in common, everyday uses.

P.S.62.

Preparation and characterization of bioactive nanocomposites curcumin-cationic gemini surfactant-silica

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Fumed amorphous silicon dioxide (SiO_2) is widely used in the pharmaceutical industry as enterosorbent, a common component in tablet-making and a matrix for creating drugs with prolonged action. The high efficiency of nanocomposites containing SiO_2 and phytocomponents (physiologically active compounds of plant origin, extracts and dispersions of medicinal plants) has been experimentally proven. The plant lipophilic polyphenol curcumin (Cur) was chosen for study as a promising component for phyto composites, since it has anti-inflammatory and antioxidant properties, exhibits pharmacological activity in the prevention and treatment of various pathological conditions and complex chronic diseases. The main problem in creating drugs using the adsorption modification method is the low degree of extraction of Cur from an aqueous solution on a SiO_2 enterosorbent. The aim of the work was complex sorption, spectral and quantum-chemical study of the interaction of natural polyphenol curcumin with nanosilica in the presence of cationic antiseptics decamethoxin and ethonium in a wide concentration range in aqueous solutions. It was found that the formation of positively charged supra-molecular complexes with cationic gemini surfactants leads to a significant increase in the adsorption of Cur on the silica surface, and its efficiency and the content of ketone and enol tautomers are determined by the structure and concentration of these antiseptics. Optimal conditions for the effective adsorption of Cur with a controlled and standardized content of its tautomers, which have different pharmacological properties, on the surface of a nanosilica enterosorbent have been developed.

P.S.63.

Targeting cancer cells by up-converting $NaGd_{0.8}Yb_{0.17}Er_{0.03}F_4$ nanoparticles

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In current medical research, biological imaging holds an important position in diagnostics, as it allows visualization of cell morphology and the processes occurring within them. As a result, considerable attention has been directed towards the development of novel types of biomarkers, including up-converting nanoparticles (UCNP) optically active under near-infrared (NIR) radiation. Lanthanide-doped UCNPs offer advantages over currently used fluorophores, due to the absence of tissue autofluorescence, minimized local heating, non-bleaching, and stable response. In this work, biocompatible $NaGd_{0.8}Yb_{0.17}Er_{0.03}F_4$ UCNPs nanoparticles were synthesized through one-pot solvothermal processing with assistance of chitosan. Obtained nanoparticles were analyzed by X-ray powder diffraction (XRPD), field emission scanning electron microscopy (FE-SEM), transmission electron microscopy (TEM), Fourier transform infrared (FTIR) and photoluminescence (PL) spectroscopy. The findings confirmed crystallization of the cubic crystals with a good luminescence response. To assess the biological safety of their use, a cytotoxicity test was conducted. Additionally, nanoparticles were conjugated with anti-human CD44 antibodies labeled with fluorescein isothiocyanate (FITC) and incubated with HS-5 fibroblasts and oral squamous cell carcinoma OSCC cells. Scanning laser microscopy is used for *in vitro* imaging of labeled cells. Based on the colocation of the FITC and UCNPs signals, selective labeling of OSCC cells was verified.

P.S.64.

Characterization of semicrystalline peptide-based biomaterials

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Crystalline and semicrystalline peptide-based bio/materials have gained significant interest due to their unique structural properties and functional versatility. These materials are formed by the self-assembly of peptides, driven by hydrogen bonding, π-π stacking, van der Waals forces, and hydrophobic interactions. Crystalline peptides form highly ordered structures with precise molecular packing, making them useful in organic electronics, biosensing, and catalysis. In contrast, semicrystalline peptides contain both ordered and disordered domains, offering a balance of mechanical strength and flexibility, making them suitable for drug delivery, tissue engineering, and bioelectronics. The crystallinity of these materials is influenced by amino acid composition, peptide length, sequence, and environmental factors such as solvent conditions. While these materials hold promise for various applications, challenges remain in achieving scalable production, precise structural control, and effective integration into functional devices. Future research thus aims to find a reliable strategy allowing to describe the strucure and segmental dynamics of these materials not only at atomic resolution level but also in real time. The power of the newly developed approach of machine-learning guided NMR crystallography is demonstrated on the de novo determination of the crystal structure of the chemotactic N-formyl-L-Met-L-Leu-L-Phe-OH tripeptide, a typical model for compounds with antimicrobial activity. This study demonstrates the synergistic effects of the combination of several experimental and computational techniques, which significantly extends the NMR crystallography approach to the field of complex mixtures and nanostructured composites and hybrid materials.

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P.S.65.

Frontiers in Surface Engineering: Shaping the Next Generation of Titanium-Based Biomedical Implants

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Titanium and its alloys have become the leading metallic materials for biomedical applications due to their favourable mechanical and physical properties, corrosion resistance, and biocompatibility. However, despite these advantages, challenges such as insufficient bioactivity, limited wear resistance, and inadequate biomechanical stability in physiological environments necessitate further improvements. Over the past decade, multifunctional surface modification techniques have become indispensable treatments in the processing of titanium-based biomaterials to optimize their performance. This study aims to review and analyze our and recent research on the application of surface modification methods in processing titanium-based biomaterials and the ability to enhance characteristics such as biocompatibility, corrosion resistance, and surface modulus of elasticity, with a focus on using advanced hybrid modification methods: severe plastic deformation and surface modification. Surface modification methods such as anodic oxidation, plasma electrolytic oxidation, laser surface treatment, chemical etching, and physical and chemical vapour deposition have been shown to improve surface topography, wettability, biomechanical interactions, and reduce bacterial adhesion. These improvements lead to increased corrosion and wear resistance, key factors for the long-term success of orthopaedic, dental, and cardiovascular implants. Anodic oxidation is a surface modification technique that allows precise control of surface morphology and characteristics, significantly enhancing the biological, mechanical, and corrosion behaviour of metallic implants. Furthermore, advanced hybrid methods, including the combination of severe plastic deformation and anodic oxidation, have demonstrated synergistic effects producing nanostructured surfaces with superior functional properties. Surface modification engineering is a critical component in the development and processing of next-generation titanium-based biomaterials.

P.S.66.

Correlation between synthesis parameters and properties of dextran-based hydrogels intended for target delivery of antitumor drugs to the colon

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Dextran-based hydrogels are promising candidates for targeted drug delivery to the colon due to their inherent biodegradability by colonic microflora. This study investigates the correlation between synthesis parameters and the resulting structural, swelling, morphological, and mechanical properties of novel dextran hydrogels. All gels were synthesized in dimethyl sulfoxide (DMSO) as the solvent, maintaining consistent weight ratios of crosslinking agents, initiator, and solvent. Diethylene glycol diacrylate (DEGDA) and divinylbenzene (DVB) were employed as crosslinking agents, also at the same weight ratio. For comparative analysis, one hydrogel was synthesized without any crosslinking agent. The synthesized materials were thoroughly characterized to assess their structural integrity, swelling behavior at physiologically relevant pH values of 3 and 6, surface morphology, and mechanical strength. Our findings reveal that subtle variations in the presence or absence of crosslinking agents, even under otherwise identical synthesis conditions, strongly influenced the ultimate properties of the hydrogels. These observed differences are crucial for tailoring dextran-based hydrogels to optimize their performance for the targeted delivery of antitumor drugs specifically within the colon.

AUTHOR INDEX

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