INSTITUTE OF TECHNICAL SCIENCES OF SASA
MATERIALS RESEARCH SOCIETY OF SERBIA

Programme and the Book of Abstracts

TWENTY-FIRST YOUNG RESEARCHERS' CONFERENCE MATERIALS SCIENCE AND ENGINEERING

Belgrade, November 29 – December 1, 2023

TWENTY-FIRST YOUNG RESEARCHERS' CONFERENCE
MATERIALS SCIENCE AND ENGINEERING

November 29 – December 1, 2023, Belgrade, Serbia

Program and the Book of Abstracts

Materials Research Society of Serbia
&
Institute of Technical Sciences of SASA

2023

Book title:
Twenty-First Young Researchers' Conference - Materials Science and Engineering: Program and the Book of Abstracts

Publisher:
Institute of Technical Sciences of SASA
Knez Mihailova 35/IV, 11000 Belgrade, Serbia
Tel: +381-11-2636994, 2185263, http://www.itn.sanu.ac.rs

Conference organizers:
Materials Research Society of Serbia, Belgrade, Serbia
Institute of Technical Sciences of SASA, Belgrade, Serbia

Editor:
Dr. Smilja Marković

Technical Editor:
Aleksandra Stojičić and Dr. Ivana Dinić

Cover page: Smilja Marković
Cover: Nebojša Labus

Printing:
Gama digital centar
Autoput No. 6, 11070 Belgrade, Serbia
Tel: +381-11-6306992, 6306962
http://www.gdc.rs

Publication year: 2023

Print-run:
120 copies

CIP - Каталогизација у публикацији

Народна библиотека Србије, Београд

66.017/.018(048)

YOUNG Researchers Conference Materials Sciences and Engineering (21 ; 2023 ; Beograd)
Program ; and the Book of abstracts / Twenty-first Young Researchers' Conference Materials Science and Engineering, November 29 – December 1, 2023, Belgrade, Serbia ; [organizers] Materials Research Society of Serbia & Institute of Technical Sciences of SASA ; [editor Smilja Marković]. - Belgrade : Institute of Technical Sciences of SASA, 2023 (Belgrade : Gama digital centar). - XX, 99 str. ; 23 cm

Tiraž 120. - Registar.

ISBN 978-86-80321-38-7

а) Наука о материјалима -- Апстракти б) Технички материјали -- Апстракти
COBISS.SR-ID 130053385

Aim of the Conference

Main aim of the conference is to enable young researchers (post-graduate, master or doctoral student, or a PhD holder younger than 35) working in the field of materials science and engineering, to meet their colleagues and exchange experiences about their research.

Topics

Biomaterials
Environmental science
Materials for high-technology applications
Materials for new generation solar cells
Nanostructured materials
New synthesis and processing methods
Theoretical modelling of materials

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Katarina Aleksić, Marko Jelić, Rauany Cristina Lopes Francisco, Tamara Matić, Nina Tomić.

Results of the Conference

Beside printed «Program and the Book of Abstracts», which is disseminated to all conference participants, selected and awarded peer-reviewed papers will be published in journal "Tehnika – Novi Materijali". The best presented papers, suggested by Session Chairpersons and selected by Awards Committee, will be proclaimed at the Closing Ceremony. Part of the award is free-of-charge conference fee at YUCOMAT 2024.

Sponsors

Acknowledgement

The editor and the publisher of the Book of abstracts are grateful to the Ministry of Science, Technological Development and Innovation of the Republic of Serbia for its financial support of this book and The Twenty-First Young Researchers' Conference - Materials Sciences and Engineering, held in Belgrade, Serbia.

Programme
Twenty-First Young Researchers Conference
Materials Science and Engineering

Wednesday, November 29, 2023

09.00 – 09.30 Opening Ceremony

09.30 – 11.15 1st Session – Biomaterials I
Chairpersons: Prof. Dr. Bojana Obradović and Katarzyna Pastuszak

09.30 – 09.45 Dental cements based on α-tricalcium phosphate and boron nitride: Synthesis, mechanical and antibacterial properties and bioactivity
Ivana Šarić[1], Tamara Vlajić-Tovilović[2], Đorđe Veljović[1]
[1]Faculty of Technology and Metallurgy, University of Belgrade, Serbia, [2]School of Dental Medicine, University of Belgrade, Serbia

09.45 – 10.00 Development of macroporous bioceramic materials based on multi-ion doped calcium-hydroxyapatite coated with chitosan
Teodora Jakovljević[1], Jelena Stanisavljević[1], Tamara Matić[1], Julijana Tadić[2], Đorđe Veljović[1]
[1]University of Belgrade, Faculty of Technology and Metallurgy, Belgrade, Serbia, [2]Vinča Institute of Nuclear Science, University of Belgrade, Serbia

10.00 – 10.15 Synthesis of nanoparticles based on RuBisCO protein derived from pumpkin leaves for the controlled release of vitamin B12
Dora B. Mikašinović, Jelena R. Mijalković, Zorica D. Knežević-Jugović
University of Belgrade, Faculty of Technology and Metallurgy, Karnegijeva 4, 11020 Belgrade, Serbia

10.15 – 10.30 Starch aerogels impregnated using supercritical CO_2: Application in controlled release of biologically active compounds
Filip Koldžić, Stoja Milovanović, Ivana Lukić, Melina Kalagasidis Krušić
University of Belgrade – Faculty of Technology and Metallurgy

10.30 – 10.45 Evaluation of the anti-inflammatory potential of *Paeonia tenuifolia* L. petal extract
Natalija Čutović[1], Tatjana Marković[1], Tamara Carević[2], Dejan Stojković[2], Branko Bugarski[3], Aleksandra A. Jovanović[4]

[1]Institute for Medicinal Plants Research "Dr Josif Pančić", Tadeuša Košćuška 1, 11000 Belgrade, Serbia, [2]Department of Plant Physiology, Institute for Biological Research "Siniša Stanković"—National Institute of Republic of Serbia, University of Belgrade, Bulevar Despota Stefana 142, 11000 Belgrade, Serbia, [3]Faculty of Technology and Metallurgy, University of Belgrade, Karnegijeva 4, 11000 Belgrade, Serbia, [4]Institute for the Application of Nuclear Energy INEP, University of Belgrade, Banatska 31b, Zemun, 11080 Belgrade, Serbia

10.45 – 11.00 Comparison of model bacterial membranes of selected *Legionella* species
Małgorzata Jurak[1], Katarzyna Pastuszak[1], Agnieszka Ewa Wiącek[1], Bożena Kowalczyk[2], Jacek Tarasiuk[2], Marta Palusińska-Szysz[2]
[1]Department of Interfacial Phenomena, Institute of Chemical Sciences, Faculty of Chemistry, Maria Curie-Skłodowska University, Maria Curie-Skłodowska Sq. 3, 20-031 Lublin, Poland, [2]Department of Genetics and Microbiology, Institute of Biological Sciences, Faculty of Biology and Biotechnology, Maria Curie-Skłodowska University, Akademicka 19, 20-033 Lublin, Poland

11.00 – 11.15 Study on interactions between the LL-37 peptide and model bacterial membranes
Katarzyna Pastuszak[1], Małgorzata Jurak[1], Agnieszka Ewa Wiącek[1], Bożena Kowalczyk[2], Jacek Tarasiuk[2], Marta Palusińska-Szysz[2]
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11.15 – 11.30 Break

11.30 – 13.00 2nd Session – Biomaterials II
Chairpersons: Dr. Ivana Drvenica and Nina Tomić

11.30 – 11.45 Activity of resveratrol nanobelt-like particles against *Pseudomonas aeruginosa* biofilms
Nina Tomić[1], Nenad Filipović[1], Dragana Mitić Ćulafić[2], Tea Ganić[2], Sergey Klyagin[3], Alexander Osmolovskiy[3], Magdalena M. Stevanović[1]
[1]Group for Biomedical Engineering and Nanobiotechnology, Institute of Technical Sciences of SASA, Belgrade, Serbia, Knez Mihailova 35/IV 11000 Belgrade, Serbia, [2]University of Belgrade – Faculty of Biology; Studentski trg 16, Belgrade, Serbia, [3]Department of Microbiology, Faculty of Biology, Lomonosov Moscow State University; Russia 119234, Moscow, Leninskie gory, 1, building 12

11.45 – 12.00 Cultivation of bone cells from different sources in a biomimetic 3D *in vitro* bone model based on alginate scaffolds and a perfusion bioreactor

Ivana Banicevic[1], Mia Milosevic[1,2], Jelena Petrovic[1,2], Ksenia Menshikh[3], Milena Milivojevic[4], Milena Stevanovic[4], Radmila Jankovic[5], Andrea Cochis[3], Elena Della Bella[6], Jasmina Stojkovska[1], Martin Stoddart[6], Lia Rimondini[3], Bojana Obradovic[1]
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12.00 – 12.15 Tuneable alginate hydrogel microfibers to support 3D cultures of cancer cells requiring different culture media

Jelena Petrović[1,2], Jasmina Stojkovska[1], Miodrag Dragoj[3], Milica Pešić[3], Milena Milivojević[4], Luka Bojić[4], Milena Stevanović[4,5], Radmila Janković[6], Bojana Obradović[1]
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12.15 – 12.30 Influence of synthesized calcium phosphate-based nanomaterial on proliferation of dental pulp stem cells in various *in vitro* conditions

Milica Tomić[1], Sanja Stojanović[1,2], Nenad Ignjatović[3], Stevo Najman[1,2]
[1]University of Niš, Faculty of Medicine, Scientific Research Center for Biomedicine, Department for Cell and Tissue Engineering, 18000 Niš, Serbia, [2]University of Niš, Faculty of Medicine, Department of Biology and Human Genetics, 18000 Niš, Serbia, [3]Institute of Technical Sciences of the Serbian Academy of Science and Arts, 11000 Belgrade, Serbia

12.30 – 12.45 Comparative analysis of subcutaneous tissue reaction to different collagen membranes with or without addition of blood

Milena Radenković Stošić[1], Sanja Stojanović[1,2], Mike Barbeck[3], Stevo Najman[1,2]
[1]University of Niš, Faculty of Medicine, Scientific Research Center for Biomedicine, Department for Cell and Tissue Engineering, 18000 Niš, Serbia, [2]University of Niš, Faculty of Medicine, Department of Biology and Human Genetics, 18000 Niš, Serbia, [3]Clinic and Policlinic for Dermatology and Venereology, University Medical Center Rostock, 18057 Rostock, Germany

12.45 – 13.00 Study of the properties of oxidized cellulose plus bioglass as a new bioink for application in regenerative medicine

Rauany Cristina Lopes[1], Mônica Rosas Costa Iemma[1], Luiz Henrique Montrezor[1], André Capaldo Amaral[1], Lidija Mančić[2], Eliane Trovatti[1]

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13.00 – 14.00 Lunch break

14.00 – 15.30 3rd Session – Biomaterials III
Chairpersons: Prof. Dr. Đorđe Veljović and Milica Marković

14.00 – 14.15 Nanofabrication and characterisation of magnetic Fe_3O_4 nanostructures for potential environmental and biomedical applications
Dušan Milojkov[1], Ana Mraković[2], Gvozden Jovanović[1], Nikola Vuković[1], Mladen Bugarčić[1], Anja Antanasković[1], Vukosava Živković-Radovanović[3]
[1]Institute for Technology of Nuclear and other Mineral Raw Materials, 11000 Belgrade, Serbia, [2]Vinca Institute for Nuclear Science, University of Belgrade, 11351 Belgrade, Serbia, [3]Faculty of Chemistry, University of Belgrade, 11158 Belgrade, Serbia

14.15 – 14.30 Peroxidase-like activity of chitosan modified magnetic nanoparticles
Iryna Khmara, Iryna Antal, Alena Jurikova, Martina Kubovcikova, Vlasta Zavisova, Martina Koneracka
Institute of Experimental Physics, SAS, Watsonova 47, Kosice, Slovakia

14.30 – 14.45 Towards new approaches for Ultraviolet sterilization of MXenes
Yuliia Varava[1,2], Volodymyr Deineka[1,3], Valeriia Korniienko[1], Kateryna Diedkova[1,3], Viktoriia Korniienko[1,3], Veronika Zahorodna[4], Oleksiy Gogotsi[4], Maksym Pogorielov[1,3]
[1]Sumy State University, Sumy, Ukraine, [2]Silesian University of Technology, Gliwice, Poland, [3]University of Latvia, Riga, Latvia; [4]Materials Research Center LTD, Kyiv, Ukraine

14.45 – 15.00 Atomic and molecular spectroscopic analysis of chemically treated pig shoulder bone: possible application in forensics
Milica Marković, Miroslav Kuzmanović, Dušan Dimić
University of Belgrade, Faculty of Physical Chemistry, Studentski trg 12-16, 11000 Belgrade, Serbia

15.00 – 15.15 Application of polylactide (PLA) biomaterial in various fields of medicine
Zorana Z. Stoisavljević[1,2], Slobodanka P. Galović[2], Katarina Lj. Đorđević[2]
University of Belgrade, [1]Faculty of Biomedical Engineering and Technologies, Belgrade, Serbia, [2]Institute for Nuclear Sciences Vinča, Laboratory for radiation physics and chemistry, Belgrade, Serbia

15.15 – 15.30 The material for the treatment of periapical granulomas
Kuzenko Yevhen, Roman Moskalenko, Kuzenko Olena
Department of Pathology, Sumy State University, Sumy, Ukraine

15.30 – 15.45 Break

15.45 – 17.15 4th Session – Environmental Materials I
Chairpersons: Prof. Dr. Ljiljana Damjanović-Vasilić and Danijela Smiljanić

15.45 – 16.00 Bentonite modified with cationic surfactant as promissing adsorbent for carbamazepine
Danijela Smiljanić, Aleksandra Daković, Milena Obradović, Milica Ožegović, Marija Marković
Institute for Technology of Nuclear and Other Mineral Raw Materials, Franše d' Epere 86

16.00 – 16.15 Assisted phytostabilization of Pb-contaminated soil using brushite-metakaolin geopolymer materials and *Festuca rubra*
Dunja Djukić[1], Tomica Mišljenović[1], Gordana Andrejić[2], Uroš Aleksić[2], Ksenija Jakovljević[1], Miljana Mirković[3]
[1]University of Belgrade, Faculty of Biology, Belgrade, Serbia, [2]Department of Agrochemistry and Radioecology, Institute for the Application of Nuclear Energy, University of Belgrade, Zemun, Serbia, [3]Department of Materials, "Vinča" Institute of Nuclear Sciences-National Institute of the Republic of Serbia, University of Belgrade, Belgrade, Serbia

16.15 – 16.30 Improvement of sorption properties of natural clay pyrophyllite by ultrasonic treatment
Katarina Tošić, Anđela Mitrović Rajić, Sanja Milošević Govedarović, Sara Mijaković, Ana Vujačić Nikezić, Jasmina Grbović Novaković, Bojana Paskaš Mamula
Centre of Excellence for Hydrogen and Renewable Energy, Vinča Institute of Nuclear Sciences - National Institute of the Republic of Serbia, University of Belgrade, POB 522, Belgrade, Serbia

16.30 – 16.45 The impact of thermal treatment on spent coffee grounds for chlorpyrifos removal from water
Vedran Milanković[1], Tamara Tasić[1], Snežana Brković[1], Igor Pašti[2], Tamara Lazarević-Pašti[1]
[1]Laboratory of Physical Chemistry, Vinča Institute of Nuclear Sciences – National Institute of the Republic of Serbia, University of Belgrade, Belgrade, Serbia, [2]Faculty of Physical Chemistry, University of Belgrade, Belgrade, Serbia

16.45 – 17.00 Applying carbon materials derived from cellulose for the removal of malathion and chlorpyrifos in food processing
Tamara Tasić[1], Vedran Milanković[1], Igor Pašti[2], Tamara Lazarević-Pašti[1]
[1]Laboratory of Physical Chemistry, Vinča Institute of Nuclear Sciences – National Institute of the Republic of Serbia, University of Belgrade, Belgrade, Serbia, [2]Faculty of Physical Chemistry, University of Belgrade, Belgrade, Serbia

17.00 – 17.15 Quality control of gas flow proportional counter for beta spectrometric determination of ^{90}Sr
Nataša Sarap[1], Stefana Dejković[2], Marija Janković[1], Jelena Krneta Nikolić[1], Vojislav Stanić[1], Milica Rajačić[1]
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17.15 – 17.30 Break

17.30 – 18.45 5th Session – Environmental Materials II
Chairpersons: Dr. Smilja Marković and Miomir Krsmanović

17.30 – 17.45 Application of thin-layer chromatography in the assessment of lipophilicity of chloroacetamide derivatives'
Dragana Mekić, Đenđi Vaštag, Suzana Apostolov
University of Novi Sad, Faculty of Sciences, Department of Chemistry, Biochemistry and Environmental Protection, Novi Sad, Serbia

17.45 – 18.00 Microplastics in urban soils of Belgrade: Abundance and potential sources
Ivana Mikavica[1], Dragana Ranđelović[1], Miloš Ilić[2], Milena Obradović[1], Jovica Stojanović[1], Jelena Mutić[2]
[1]Institute for Technology of Nuclear and other Mineral Raw materials, Boulevard Franchet d`Esperey 86, Belgrade, Serbia, [2]University of Belgrade, Faculty of Chemistry, Studentski trg 12 - 16, P. O. Box 51, 11158, Belgrade, Serbia

18.00 – 18.15 Microbial degradation of terephtalic acid as a PET-derived compound
Natalija Petronijević[1], Marija Lješević[2], Branka Lončarević[2], Kristina Joksimović[2], Gordana Gojgić-Cvijović[2], Vladimir Beškoski[1], Jasmina Nikodinović-Runić[3]
[1]University of Belgrade, Faculty of Chemistry, [2]University of Belgrade, Institute of Chemistry, Technology and Metallurgy, [3]University of Belgrade, Institute of Molecular Genetics and Genetic Engineering

18.15 – 18.30 Immobilization of nickel ions into stable crystal structures as a promising way for their removal from wastewater
Miomir Krsmanović[1], Aleksandar Popović[2], Željko Radovanović[3], Smilja Marković[4], Mia Omerašević[1]
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Belgrade, Karnegijeva 4, Belgrade, Serbia, [4]Institute of Technical Sciences of the Serbian Academy of Sciences and Arts, Knez Mihailova 35/IV, Belgrade, Serbia

18.30 – 18.45 Particularities of the isolation of rare earth elements from mechanochemically modified brown coals
Lidiya I. Yudina[1,2], Tatiana S. Skripkina[2], Svetlana S. Shatskaya[2], Uliana E. Nikiforova[2]
[1]Novosibirsk state university, Faculty of natural sciences, Novosibirsk, Russia, [2]Institute of solid state chemistry an mechanochemisty, Novosibirsk, Russia

Thursday, November 30, 2023

09.00 – 11.00 6th Session – Theoretical Modeling of Materials
Chairpersons: Dr. Marko Opačić and Kristina Stevanović

09.00 – 09.15 Quinuclidine thiosemicarbazone crystal structure determination: Quantum insights via Hirshfeld atom refinement and intermolecular interaction energies
Milica G. Bogdanović[1], Vidak N. Raičević[2], Marko V. Rodić[1]
[1]University of Novi Sad, Faculty of Sciences, Novi Sad, Serbia, [2]University of Novi Sad, Faculty of Medicine, Novi Sad, Serbia

09.15 – 09.30 Computational modeling vs. experimental analyses of the energetic performance of pyrotechnic mixtures and explosives
Jelena Mojsilović[1], Mladen Timotijević[1], Mirjana Krstović[1,2], Jelena Petković-Cvetković[1], Bojana Fidanovski[1,2], Danica Bajić[1,2]
[1]Military Technical Institute, Belgrade, Serbia, [2]Military Academy, Belgrade, Serbia

09.30 – 09.45 Composite PBX explosives with different polymer binders
Mirjana Krstović[1,2], Danica Bajić[1,2], Mladen Timotijević[1], Jelena Mojsilović[1], Slavica Terzić[1]
[1]Military Technical Institute, Belgrade, Serbia, [2]Military Academy, University of Defense, Belgrade, Serbia

09.45 – 10.00 Modelling the detonation pressure of phlegmatized explosives in EXPLO5
Mladen Timotijević, Danica M. Bajić, Slavica Terzić
Military Technical Institute, Belgrade, Serbia

10.00 – 10.15 QSAR and machine learning models of redox potentials of some organic pigments
Kristina Stevanović[1], Jelena Maksimović[2], Jelena Senćanski[3], Maja Pagnacco[4], Milan Senćanski[5]

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10.15 – 10.30 The photogenerated excess carriers influence on the photoacoustic signal of a narrow bandgap semiconductor
Milica A. Dragaš[1,2], Slobodanka P. Galović[3], Katarina Lj. Đorđević[3]
[1]Faculty of Physics, University of Belgrade, 12 Studentski trg, 11001 Belgrade, Serbia, [2]Faculty of Philosophy, University of East Sarajevo, 1 Alekse Santica, 71420 Pale, Bosnia and Herzegovina, [3]Vinča Institute of Nuclear Sciences, National Institute of the Republic of Serbia, University of Belgrade, 12-14 Mike Petrovica Alasa, 11351 Vinča, Belgrade, Serbia

10.30 – 10.45 Density functional theory calculation of the optical properties of graphene quantum dots
Tatjana Agatonović Jovin, Biljana Todorović Marković, Zoran Marković
Vinča Institute of Nuclear Sciences – National Institute of the Republic of Serbia, University of Belgrade, P.O. Box 522, 11001 Belgrade, Serbia

10.45 – 11.00 Oxygen-terminated Ti3C2 MXene as an excitonic insulator
Nilesh Kumar, František Karlický
Department of Physics, Faculty of Science, University of Ostrava, 30. dubna 22, 701 03 Ostrava, Czech Republic

11.00 – 11.15 Break

11.15 – 12.45 7th Session – Nanostructured Materials I
Chairpersons: Dr. Dragana Jugović and Katarina Aleksić

11.15 – 11.30 Hydrogen storage properties of MgH_2-Ni system
Milica Prvulović[1], Bojana Babić[1], Nenad Filipović[2], Željko Mravik[1], Sanja Milošević Govedarović[1], Zorana Sekulić[3], Igor Milanović[1]
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11.30 – 11.45 Temperature dependence of electric properties of GO and GO/WPA films on interdigital electrodes
Željko Mravik[1], Milica Pejčić[2], Marija Grujičić[2], Jelena Rmuš Mravik[1], Miša Stević[3], Zoran Stević[4,5], Zoran Jovanović[1]

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11.45 – 12.00 Electrochemically exfoliated graphene as support of platinum nanoparticles for methanol oxidation reaction and hydrogen evolution reaction
Jelena P. Georgijević, Irina Srejić, Mirjana Novaković, Lazar Rakočević, Jelena Potočnik, Aleksandar Maksić
Vinča Institute of Nuclear Sciences – National Institute of the Republic of Serbia, University of Belgrade, P.O. Box 522, Belgrade, 11001, Serbia

12.00 – 12.15 $ZnO@RuO_2$ composites: Cost-effective trifunctional electrocatalysts for enhanced OER, HER, and ORR activities in water electrolysis
Katarina Aleksić[1], Ivana Stojković Simatović[2], Smilja Marković[1]
[1]Institute of Technical Sciences of SASA, Belgrade, Serbia, [2]Faculty of Physical Chemistry, University of Belgrade, Belgrade, Serbia

12.15 – 12.30 Investigating the influence of hydrothermal treatment on oxygen functional groups in graphene oxide-based nanocomposites
Milica Pejčić[1], Željko Mravik[1], Danica Bajuk-Bogdanović[2], Marija Grujičić[1], Jelena Rmuš Mravik[1], Sonja Jovanović[1], Zoran Jovanović[1]
[1]Laboratory of Physics, Vinča Institute of Nuclear Sciences – National Institute of the Republic of Serbia, University of Belgrade, Belgrade, Serbia, [2]Faculty of Physical Chemistry, University of Belgrade, Belgrade, Serbia

12.30 – 12.45 Enhanced electrochemical detection of gallic acid using modified glassy carbon electrodes with Zn/Ga-dopped cobalt ferrite
Marija Grujičić[1], Marko Jelić[1], Ivana Stojković Simatović[2], Danica Bajuk Bogdanović[2], Darija Petković[1], Zoran Jovanović[1], Sonja Jovanović[1]
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12.45 – 13.45 Lunch break

13.45 – 15.15 8th Session – Nanostructured Materials II
Chairpersons: Dr. Ana Stanković and Tijana Stamenković

13.45 – 14.00 Yb^{3+}/Tm^{3+} doped $SrGd_2O_4$ as photoluminescent and photocatalytic material

Tijana Stamenković[1], Marjan Ranđelović[2], Ivana Dinić[3], Lidija Mančić[3], Vesna Lojpur[1]
[1]Department of Atomic Physics, Vinča Institute of Nuclear Sciences, National Institute of the Republic of Serbia, P.O. Box 522, 11001 Belgrade, University of Belgrade, Serbia, [2]Faculty of Science and Mathematics, University of Niš, Niš, Serbia, [3]Institute of Technical Science of SASA, Knez-Mihailova 35/4, Belgrade, Serbia

14.00 – 14.15 Physicochemical characterization of mechanochemically activated pyrophyllite/Ag composites
Sara Mijaković, Jasmina Grbović Novaković, Katarina Tošić, Anđela Mitrović Rajić, Bojana Paskaš Mamula, Ana Vujačić Nikezić
Centre of Excellence for Renewable and Hydrogen Energy, "Vinča" Institute of Nuclear Sciences, National Institute of Republic of Serbia, University of Belgrade, POB 522, 11000 Belgrade

14.15 – 14.30 Measurement of EMI shielding perfomance of graphene oxide – silver nanoparticles composites
Anđela Stefanović[1,2], Dejan Kepić[1], Svetlana Jovanović Vučetić[1], Kamel Haddadi[3], Biljana Todorović Marković[1]
[1]Vinča Institute of Nuclear Sciences - National Institute of the Republic of Serbia, University of Belgrade P.O. Box 522, 11000 Belgrade, Serbia, [2]Faculty of Chemistry, University of Belgrade, Studentski trg 12-16, 11158, Belgrade, Serbia, [3]University of Lille, CNRS, Centrale Lille, University Polytechnique Hauts-de-France, UMR 8520-IEMN, F-59000 Lille, France

14.30 – 14.45 Plasmon induced enhancement of photoinduced antibacterial activity of graphene quantum dots
Slađana Dorontić, Svetlana Jovanović, Biljana Todorović Marković
,,Vinča"-Institute of Nuclear Sciences - National Institute of the Republic of Serbia, University of Belgrade P.O. Box 522, 11000 Belgrade, Serbia

14.45 – 15.00 Innovative modifications of graphene quantum dots for improved photodynamic therapy in antibacterial treatment
Mila Milenković, Slađana Dorontić, Biljana Todorović Marković, Svetlana Jovanović
Vinča Institute of Nuclear Sciences – National Institute of the Republic of Serbia, University of Belgrade, P.O. Box 522, 11000 Belgrade, Serbia

15.00 – 15.15 Enhanced photocatalytic performance of $BaTiO_3/MoO_3$/Ag ternary heterostructure
Kevin V. Alex[1,2], Jose P. B. Silva[3], K. Kamakshi[4], K. C. Sekhar[1]
[1]Department of Physics, School of Basic and Applied Sciences, Central University of Tamil Nadu, Thiruvarur, 610-005, India, [2]International & Inter University Centre for Nanoscience & Nanotechnology, Mahatma Gandhi University, Kottayam, 686-560, India, [3]Physics Center of Minho and Porto Universities (CF-UM-UP), University of Minho, Campus de Gualtar, 4710-057 Braga, Portugal, [4]Department of Science and Humanities, Indian Institute of Information Technology, Thiruchirapalli, 620-012, India

15.15 – 15.30 Break

15.30– 17.15 9th Session – Nanostructured Materials III
Chairpersons: Dr. Ivana Dinić and Marko Jelić

15.30 – 15.45 Thin film deposition of multilayers on silicon substrate laser pre-patterned
Nevena Božinović, Suzana Petrović, Mirjana Novaković, Vladimir Rajić
Vinca Institute of Nuclear Sciences – National Institute of the Republic of Serbia, University of Belgrade, P.O. Box 522, Belgrade, 11001, Serbia

15.45 – 16.00 UV protection with novel porous organosilica nanoparticles
Aleksandra Pavlović[1], Nikola Knežević[1], Irena Miler[1], Mihailo Rabasović[2]
[1]Institute BioSense, University of Novi Sad, Serbia, [2]Institute of Physics, Belgrade

16.00 – 16.15 Photoelectrochemical water oxidation properties of bismuth vanadate photoanode irradiated by swift heavy ions
Marko Jelić[1], Ekaterina Korneeva[2], Nikita Kirilkin[2], Tatiana Vershinina[2], Oleg Orelovich[2], Vladimir Skuratov[2], Zoran Jovanović[1], Sonja Jovanović[1]
[1]Laboratory of Physics, Vinča Institute of Nuclear Sciences – National Institute of the Republic of Serbia, University of Belgrade, Belgrade, Serbia, [2]Joint Institute for Nuclear Research, Dubna, Russia

16.15 – 16.30 Improvement of Au-poly(N-isopropylacrylamide) hydrogel nanocomposites: Single-layer vs. bi-layered systems
Nikolina Nikolić, Jelena Spasojević, Una Stamenović, Vesna Vodnik, Ivana Vukoje, Zorica Kačarević-Popović, Aleksandra Radosavljević
Vinča Institute of Nuclear Sciences, National Institute of the Republic of Serbia, University of Belgrade, Belgrade, Serbia

16.30 – 16.45 Radiological and structural analysis of aluminosilicate materials incorporated with samarium (III)-oxide
Sanja Knežević[1], Miloš Nenadović[2], Jelena Potočnik[2], Danilo Kisić[2], Milica Rajačić[3], Snežana Nenadović[1], Marija Ivanović[1]
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16.45 – 17.00 Comparison of the conventional and green microemulsion synthesis of the manganese oxide nanoparticles

Tatjana Baljak[1], Stéphane Pronier[2], Celine Fontaine[2], Ranka Šatara[1], Radojka Jandrić[1], Slađana Ćetojević[1], Smiljana Paraš[1], Suzana Gotovac Atlagić[1]
[1]University of Banja Luka, Faculty of Natural Sciences, Chemistry Department, Mladena Stojanovića 2, 78000, Banja Luka, Republic of Srpska, Bosnia and Herzegovina, [2]Université de Poitiers, Institut de Chimie des Milieux et Matériaux de Poitiers (IC2MP), 86073 Poitiers Cedex 9, France

17.00 – 17.15 Preparation of dispersion strengthened nanocomposite with Al_2O_3 and MgO particles by spark plasma sintering
František Kromka[1], Juraj Szabó[1], Ondrej Milkovič[1], Katarína Ďurišinová[1], Nebojša Labus[2]
[1]Slovak Academy of Sciences, Institute of Materials Research, Košice, Slovak Republic, [2]Institute of Technical Sciences of SASA, Belgrade, Serbia

Friday, December 1, 2023

09.00 – 10.30 10th Session – New Synthesis and Processing Methods I
Chairpersons: Dr. Sonja Jovanović and Dr. Konrad Terpilowski

09.00 – 09.15 Properties of polymer/MXene nanocomposite films
Ivan Pešić[1], Sanja Ostojić[2], Miloš Petrović[3], Dana Vasiljević Radović[1], Milena Rašljić Rafajilović[1], Vesna Radojević[3], Marija V. Pergal[1]
[1]University of Belgrade, Institute of Chemistry, Technology and Metallurgy, Njegoseva 12, 11000, Belgrade, Serbia, [2]Institute of General and Physical Chemistry, University of Belgrade, Studentski trg 12-16, 11000, Belgrade, Serbia, [3]Faculty of Technology and Metallurgy, University of Belgrade, Karnegijeva 4, 11000 Belgrade, Serbia

09.15 – 09.30 "Green" synthesis of silver nanoparticles and their biosafety
Konrad Terpilowski[1], K. Dybkova[2], O. Goncharuk[2,3], L. Rieznichenko[2], T. Gruzina[2], S. Dybkova[2,3]
[1]Maria Curie-Sklodowska University, Poland, [2]F.D. Ovcharenko Institute of biocolloidal chemistry of NAS of Ukraine, 42 Vernadskogo Ave., Kyiv 03142, Ukraine, [3]Institute of Agrophysics, Polish Academy of Sciences, Doświadczalna 4, 20-290 Lublin, Poland

09.30 – 09.45 PLD growth of strontium titanate thin films on SrO-deoxidized and rGO-buffered Si(001) substrate
Darija Petković[1], Hsin Chia-Ho[2], Urška Trstenjak[2], Janez Kovač[3], Damjan Vengust[2], Matjaž Spreitzer[2], Zoran Jovanović[1]
[1]Laboratory of Physics, Vinča Institute of Nuclear Sciences – National Institute of the Republic of Serbia, Belgrade, Serbia, [2]Advanced Materials Department, Jožef Stefan Institute, Ljubljana, Slovenia, [3]Department of Surface Engineering, Jožef Stefan Institute, Ljubljana, Slovenia

09.45 – 10.00 Study of abnormal grain growth in cold-rolled AA5182 Al-Mg alloy
M. Ghulam Isaq Khan[1], Filip Rajković[2], Miljana Popović[1], Dejan Prelević[2], Aleksandar Ćitić[3], Tamara Radetić[1]
[1]Faculty of Technology & Metallurgy, University of Belgrade, Serbia, [2]Faculty of Mining & Geology, University of Belgrade, Serbia, [3]Military-Technical Institute, Belgrade, Serbia

10.00 – 10.15 Analysis of the change in structural parameters of mechanically alloyed Cu composite materials using different milling methods
Marko Simić[1], Emilija Nidžović[1], Željko Radovanović[2], Jovana Ružić[1]
[1]Department of Materials, "Vinča" Institute of Nuclear Sciences - National Institute of the Republic of Serbia, University of Belgrade, [2]Faculty of Technology and Metallurgy, University of Belgrade

10.15 – 10.30 Synthesis and high-temperature / high-pressure exposure of compositionally complex rock-salt-type transitional metal (carbo)nitrides
Dharma Teja Teppala[1], Shrikant Bhat[2], Leonard Keil[1], Jan Bernauer[1], Johannes Peter[3], Hans-Joachim Kleebe[3], Emanuel Ionescu[1,4]
[1]Institute for Material Science, Technical University of Darmstadt, 64287 Darmstadt, Germany, [2]Photon Science, DESY, 22607 Hamburg, Germany, [3]Institute for Applied Geosciences, Technical University of Darmstadt, 64287 Darmstadt, Germany, [4]Fraunhofer IWKS, Brentanostrasse 2a, 63755 Alzenau, Germany

10.30 – 10.45 Break

10.45 – 12.15 11th Session – New Synthesis and Processing Methods II
Chairpersons: Dr. Miloš Milović and Katarina Rondović

10.45 – 11.00 Metabolic insights through nondestructive monitoring: A case study on *Vriesea carinata*
Sara V. Ristić, Anđelija N. Mladenović, Gorana D. Madžarević, Marija M. Petković Benazzouz, Katarina M. Miletić
Faculty of Physics, University of Belgrade, Belgrade, Serbia

11.00 – 11.15 Continuous monitoring of leaf optical properties for the early pathogen detection in sweet chestnut
Anđelija N. Mladenović, Gorana D. Madžarević, Sara V. Ristić, Marija M. Petković Benazzouz, Katarina M. Miletić
Faculty of Physics, University of Belgrade, Belgrade, Serbia

11.15 – 11.30 Real-time detection of early signs of Mg and N deficiency in hydroponically grown *Ocimum basilicum*: An innovative optical approach with nutrient recovery insights
Gorana D. Madžarević, Anđelija N. Mladenović, Sara V. Ristić, Marija M. Petković Benazzouz, Katarina M. Miletić

Faculty of Physics, University of Belgrade, Belgrade, Serbia

11.30 – 11.45 Generating mesoporosity in zeolite 13X by applying mild alkaline treatment with urea solution
Katarina Rondović[1], Vladislav Rac[2], Vesna Rakić[2], Igor Pašti[1], Ljiljana Damjanović-Vasilić[1]
[1]University of Belgrade, Faculty of Physical Chemistry, Belgrade, Serbia, [2]University of Belgrade, Faculty of Agriculture, Belgrade, Serbia

11.45 – 12.00 A fast and efficient synthesis of gamma rays dosimeters based on metalophthalocyanines
Daliborka Odobaša[1], Bojana Vasiljević[2], Dragana Marinković[2]
[1]Faculty of Physical Chemistry, University of Belgrade, Studentski trg 12-16, 11000 Belgrade, Serbia, [2]Vinča Institute of Nuclear Sciences, National Institute of the Republic of Serbia, University of Belgrade, P. O. Box 522, 11000 Belgrade, Serbia

12.00 – 12.15 The influence of the pre-deformation and post-deformation process on hardness and microstructure of the the EN AW-7075 aluminum alloy
Avram S. Kovačević
University of Belgrade, Technical faculty in Bor, Bor, Serbia

12.15 – 13.00 Lunch break

13.00 – 14.30 12th Session – Materials for High-technology Application I
Chairpersons: Dr. Zoran Jovanović and Ljubinka Vasić

13.00 – 13.15 Utilization of carbon fiber in the context of microbial fuel cell systems
Kristina Joksimović[1], Aleksandra Žerađanin[1], Branka Lončarević[1], Marija Lješević[1], Danijela Randjelović[1], Vladimir Beškoski[2]
[1]University of Belgrade, Institute for chemistry, metallurgy and technology, National Institute of the Republic of Serbia, Njegoševa 12, Belgrade, [2]University of Belgrade, Faculty of chemistry, Studentski trg 12-16, Belgrade,Serbia

13.15 – 13.30 Polycrystalline nickel modified with rhodium as an effective electrocatalyst for hydrogen-based energy conversion technologies
Ljubinka Vasić, Nikola Tričković, Zaharije Bošković, Aleksandar Z. Jovanović, Igor A. Pašti
University of Belgrade – Faculty of Physical Chemistry, Belgrade, Serbia

13.30 – 13.45 Perspective of Ni-Sn modified Ni foams in industrial scale alkaline water electrolysis
Jelena Gojgić[1], Aleksandar Petričević[1], Mila Krstajić Pajić[1], Thomas Rauscher[2], Christian Immanuel Bernaecker[2], Vladimir Jović[3]
[1]University of Belgrade, Faculty of Technology and Metallurgy, Karnegijeva 4, 11000 Belgrade, Serbia, [2]Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM, Branch Lab Dresden, Winterbergstraße 28, 01277 Dresden, Germany,

[3]University of Belgrade, Institute for Multidisciplinary Research, Kneza Višeslava 1, 11030 Belgrade, Serbia

13.45 – 14.00 Ni-MoO_2 as electrocatalyst for hydrogen evolution reaction
A. Petricevic[1], Jelena Gojgic[1], Mila Krstajic Pajic[1], T. Rauscher[2], Christian Immanuel Bernaecker[2], Vladimir Jovic[3]
[1]University of Belgrade, Faculty of Technology and Metallurgy, Karnegijeva 4, 11000 Belgrade, Serbia, [2]Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM, Branch Lab Dresden, Winterbergstraße 28, 01277 Dresden, Germany, [3]University of Belgrade, Institute for Multidisciplinary Research, Kneza Višeslava 1, 11030 Belgrade, Serbia

14.00 – 14.15 The influence of $ZnCl_2$ on the capacitance of hydrothermally synthesized vine shoots-derived carbon
Minea Kapidžić[1], Jana Mišurović[1], Veselinka Grudić[1], Milica Vujković[2]
[1]*University of Montenegro – Faculty of Metallurgy and Technology, Cetinjski put bb, 81000 Podgorica, Montenegro,* [2]*University of Belgrade – Faculty of Physical Chemistry, Studentski trg 12-16, 11158, Belgrade, Serbia*

14.15 – 14.30 Hydrothermal carbonization of olive mill waste to electrode materials
Sonja Kastratović[1], Minea Kapidžić[1], Danilo Marković[1], Veselinka Grudić[1], Milica Vujković[2], Jana Mišurović[1]
[1]*University of Montenegro, Faculty of Metallurgy and Technology, Cetinjski put 2, 81000, Podgorica, Montenegro,* [2]*University of Belgrade – Faculty of Physical Chemistry, Studentski trg 12-16, 11158, Belgrade, Serbia*

14.30 – 14.45 Break

14.45 – 16.15 13th Session – Materials for High-technology Application II
Chairpersons: Dr. Marina Vuković and Natalia Majewska

14.45 – 15.00 Environmentally friendly cell with a rechargeable CF/AgCl-PPy cathode
Aleksandra S. Popović, Branimir N. Grgur
TMF, University of Belgrade, Serbia, Karnegijeva 4

15.00 – 15.15 The effect of homogenization conditions on microstructure and recrystallization behavior of AA5182 alloy
Aleksandar Ćitić[1], Miljana Popović[2], Tamara Radetić[2], Muhamad Ghulam Isaq Khan[2]
[1]*Military-technical Institute, Belgrade, Serbia,* [2]*Faculty of Technology and Metallurgy, University of Belgrade, Serbia*

15.15 – 15.30 Geopolymerisation of the kaolin from Bosnia and Herzegovina: Synthesis, characterization and potential application in high-tech ceramics

Marija Stojaković[1], Sunčica Sukur[1], Elvir Babajić[2], Esad Salčin[3], Zvjezdana Sandić[1], Ferenc Madai[4], Viktor Madai[4] and Suzana Gotovac Atlagić[1]
[1]University of Banja Luka, Faculty of Natural Sciences and Mathematics, Mladena Stojanovića 2, 78 000 Banja Luka, Bosnia and Herzegovina, [2]University of Tuzla, Faculty of Mining, Geology and Civil Engineering, Univerzitetska 2, Tuzla 75000, Bosnia and Herzegovina, [3]Ministry of Energy and Mining of Republic of Srpska, Trg Republike Srpske 1, 78 000 Banja Luka, Bosnia and Herzegovina, [4]University of Miskolc, Institute of Mineralogy and Geology, H-3515 Miskolc Egyetemváros, Hungary

15.30 – 15.45 Dependence of alumina/ascorbate oxidase biosensor electrocatalytic activity on alumina type
Barbara Ramadani[1], Sonja Novaković[1], Miloš Mojović[1], Zorica Mojović[2]
[1]University of Belgrade Faculty of Physical Chemistry, Studentski trg 12-16, Belgrade, Republic of Serbia, [2]University of Belgrade – Institute of Chemistry, Technology and Metallurgy, Department of Catalysis and Chemical Engineering, Njegoševa 12, Belgrade, Republic of Serbia

15.45 – 16.00 Influence of chemical and mechanical pressure on luminescence properties of Cr^{3+}-activated near-infrared phosphors
Natalia Majewska[1], Ru-Shi Liu[2], Sebastian Mahlik[1,3]
[1]Institute of Experimental Physics, Faculty of Mathematics, Physics and Informatics, University of Gdansk, Wita Stwosza 57, 80-308 Gdansk, Poland, [2]Department of Chemistry, National Taiwan University, Taipei 106, Taiwan, [3]International Centre for Theory of Quantum Technologies (ICTQT), University of Gdansk, 80-308 Gdańsk, Poland

16.00 – 16.15 Utilizing absorption spectroscopy for investigating radiochromic films in radiation dosimetry
Stevan Pecić[1], Miloš Vićić[1], Ivan Belča[1], Ljubomir Kurij[2], Strahinja Stojadinović[3], Slobodan Dević[4]
[1]Faculty of Physics, Belgrade, Serbia, [2]University Clinical Center of Serbia, Belgrade, Serbia, [3]University of Texas Southwestern Medical Center, Dallas TX, USA, [4]McGill University, Montreal, Canada

16.15 – 16.30 Break

16.30 – 17.45 14th Session – Materials for High-technology Application III and Materials for New Generation Solar Cells
Chairpersons: Dr. Vuk Radmilović and Dr. Lazar Rakočević

16.30 – 16.45 Characterization and hydrogen evolution on Pt/nanoplatelets
Lazar Rakočević[1], Jelena Golubović[2], Vladimir Rajić[1], Svetlana Štrbac[2]
[1]INN Vinca, Laboratory of Atomic Physics, University of Belgrade, Serbia, Mike Alasa 12-14, 11001 Belgrade, Serbia, [2]Institute of Chemistry, Technology and Metallurgy, Department of Electrochemistry, University of Belgrade, Njegoševa 12, 11000 Belgrade, Serbia

16.45 – 17.00 Investigation of varied dip-coating methods for the deposition of TiO_2 blocking layer of the photoanode of Dye-Sensitized Solar Cells
Evgenija Milinković, Vladislav Jovanov and Katarina Cvetanović
Department of Microelectronic Technologies, Institute of Chemistry Technology and Metallurgy, National Institute of the Republic of Serbia, University of Belgrade, Njegoseva 12, 11000 Belgrade, Serbia

17.00 – 17.15 Spin-coated TiO_2 thin films: Fabrication and characterization study
Nastasija Conic[1,2], Evgenija Milinkovic[3], Vladislav Jovanov[3], Jovana Gojanovic[1]
[1]University of Belgrade, School of Electrical Engineering, Bulevar kralja Aleksandra 73, 11120 Belgrade, Serbia, [2]University of Belgrade, Faculty of Physics, Studentski trg 12, 11001 Belgrade, Serbia, [3]University of Belgrade, Institute of Chemistry, Technology and Metallurgy, Department of Microelectronic Technologies, Njegoševa 12, 11000 Belgrade, Serbia

17.15 – 17.30 Metal complexes as potential new materials for dye-sensitized solar cells – Synthesis and characterization of Zn(II) complex with asymmetric Schiff base of 2,6-diacetylpyridine
Marijana S. Kostić, Vukadin M. Leovac, Milica G. Bogdanović, Marko V. Rodić, Mirjana M. Radanović
University of Novi Sad, Faculty of Sciences, Novi Sad, Serbia

17.30 – 17.45 The analysis of roof-integrated PV plant with the possible usage of battery energy storage system
Đorđe Jovanović[1], Branislav Milenković[2]
[1]Mathematical Institute of SASA, Department of Computer Sciences, Kneza Mihaila 36, Belgrade, Faculty of Applied Sciences, Department of Mechanical Engineering, Dušana Popovića 22a, Niš

18.00 Closing Ceremony

1-1

Dental cements based on α-tricalcium phosphate and boron nitride: Synthesis, mechanical and antibacterial properties and bioactivity

Ivana Šarić[1], Tamara Vlajić-Tovilović[2], Đorđe Veljović[1]

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[2]*School of Dental Medicine, University of Belgrade, Serbia*

Root canal therapy aims to remove pulpal and periapical inflammation and achieve maximal bacterial reduction. In addition to the application of chemical irrigants, an effective root canal filling system with potent antibacterial properties can entrap residual bacteria, insure the success of primary endodontic therapy, and prevent secondary endodontic infections. Because of their confirmed biocompatibility, bioactivity and similarity with the mineral phase of dental tissue, calcium phosphates are often researched in the field of dental medicine.The objective of the study was to process and to examine the mechanical properties (compressive strength), antibacterial properties, working time and bioactivity of dental root canal filling materials based on α-tricalcium phosphate (α-TCP) with the addition of Sr, Cu and Zn ions as well as with the addition of nanostructured boron-nitride powder. α-TCP powder was prepared by calcination of hydrothermally synthesized hydroxyapatite (HAp) at 1500 °C for 2 h. Composite cement pastes were made of α-TCP mixed powder with 1 wt.% BN and liquid component prepared by using citric acid, polyethylene glycol and water. Cement material was pressed into cylinder-shaped specimen which was then immersed in a simulated body fluid (SBF) at 37 °C for 3 and 15 days. X-ray diffraction analysis of the sintered materials showed the presence of both, α-tricalcium phosphate and HAp. Scanning electron microscopy (SEM) was used to examine the morphology of nanostructured powders, andt was showed that obtained rod-like particles have nano dimensions. The elemental analysis of the synthesized powder was determined by energy dispersive spectroscopy (EDS), which was confirmed the presence of doped Sr, Cu and Zn ions. Working time was measured and showed values of 25 minutes, in regards to undoped cement with working time of 16 minutes. Compressive strength decreased from the value of 8.24 ± 2.40 MPa (3-day immersion in SBF) to 4.61 ± 0.56 MPa after 15 days. Antibacterial properties were measured against *Enterococcus faecalis* (*E. faecalis*) where colony-forming units (CFU) were measured. Dental cement with the addition of BN reduced the biofilm CFU by about 100 CFU/ml, compared to control. These results lead to the conclusion that this type of cement could potentially be used as a root canal filling material.

1-2

Development of macroporous bioceramic materials based on multi-ion doped calcium-hydroxyapatite coated with chitosan

Teodora Jakovljević[1], Jelena Stanisavljević[1], Tamara Matić[1], Julijana Tadić[2], Đorđe Veljović[1]

[1]*University of Belgrade, Faculty of Technology and Metallurgy, Belgrade, Serbia*
[2]*Vinča Institute of Nuclear Science, University of Belgrade, Serbia*

In recent years, scientists have been working on developing biocompatible materials that closely mimic the structure and properties of natural biological tissues for their application in hard tissue regeneration and controlled drug release. Human bones and teeth primarily consist of calcium-phosphate crystals with small amounts of various ions incorporated into their crystal structure. The aim of this study was to examine the possibility of processing macroporous bioceramic scaffolds based on calcium-hydroxyapatite (HAp) doped with magnesium (Mg), strontium (Sr) and fluorine (F) ions, subsequently coated with polymer chitosan. In this study, the doped HAp powder was synthesized by a hydrothermal process, and scaffolds were made using the sponge replica method, sintered and then coated with the chitosan. The influence of dopant ions and chitosan on the scaffold's microstructure, mechanical properties, bioactivity, cytotoxicity and drug release properties was examined. Energy dispersive spectroscopy confirmed that Mg and Sr are incorporated in all powder samples, while the presence of F was confirmed in samples synthesized with 1 and 2 mol.% F in the precursor solution. The phase composition of powders and scaffolds determined by X-ray analysis showed the presence of HAp and β-tricalcium phosphate phase (β-TCP) in scaffolds. In the compressive strength (CS) test, coated scaffolds showed significantly higher CS compared to uncoated scaffolds. Scanning electron microscopy was used to examine the morphology of nanostructured powders, microstructure, and the bioactivity of the scaffolds. The uncoated scaffolds showed satisfactory bioactivity after being immersed in simulated body fluid for 28 days, while lower bioactivity was observed in the coated scaffolds due to the slow degradation of chitosan. The synthesized scaffolds also demonstrated to have a positive impact on cell viability, even slightly stimulating the cell proliferation. Additionally, scaffolds were shown to successfully release drug. In concusion, the addition of ions and chitosan polymer significantly improved the properties of the obtained scaffolds, which indicates their potential application in tissue engineering and controlled drug release.

1-3

Synthesis of nanoparticles based on RuBisCO protein derived from pumpkin leaves for the controlled release of vitamin B12

Dora B. Mikašinović, Jelena R. Mijalković, Zorica D. Knežević-Jugović

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

Pumpkin leaves which are considered biomass waste are rich in plant proteins who have an enormous potential and application in the food industry in comparison to proteins of animal origin. One of them is the most abundant protein in nature, ribulose-1,5-biphosphate carboxylase/oxygenase (RuBisCO). This protein contains various functional groups enabling numerous interactions with a substantial number of compounds which make RuBisCO a noteworthy carrier of hydrophilic and hydrophobic biologically active food components. The goal of this research paper is to illustrate and prove the hypothesis that the RuBisCO fraction can potentially be used as a carrier of vitamin B12. The first protein sample was obtained using the thermal-acidic method while the second one was obtained using the thermal precipitation method and by adding ammonium-sulfate (40% w/v). Both of the isolated samples were freeze-dried and structurally analyzed using FTIR. The big and small subunit size (55 and 15 kDa) was determined using gel electrophoresis. The protein content was determined using the Lowry method. Nanoparticles were produced using a cold gelation method, where Ca^{2+} ions were used as crosslinking agents. This process was optimized by varying the concentration of $CaCl_2$ solution in the range between 3 and 5 mM. All particles were characterized in terms of mean size, surface charge and their distribution. The turbidity values of the samples were also measured and analyzed. Particles that show the best ratio of distribution and particle size were chosen for making encapsulates. The influence of variation in vitamin B12 concentration was examined by preparing 10, 20 and 40 μg/ml concentrated solutions. Encapsulates were also characterized in terms of mean particle size, their distribution, surface charge, and morphologically using TEM and SEM analysis. The release of vitamin B12 was successfully reproduced in simulated gastrointestinal conditions, which demonstrates the potential application of RuBisCO as media for the encapsulation of important nutrients.

Acknowledgments: This research was supported by the Science Fund of the Republic of Serbia, #GRANT No 7751519, MultiPromis.

1-4

Starch aerogels impregnated using supercritical CO_2: Application in controlled release of biologically active compounds

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This research explores the potential of starch aerogels impregnated with thymol, carvacrol and eugenol using supercritical CO_2 as systems for controlled release of these biologically active compounds. Controlled release systems offer a solution to challenges related to inadequate dosing of active substances and the need to reduce application frequency, with the primary objective of maintaining a constant concentration of the active compounds in the target tissue over an extended period. Such systems can be made from biocompatible and biodegradable polymers, such as the readily available and cost-effective starch, which has been processed into aerogels. Aerogels are characterized by their high porosity and substantial specific surface area, making them highly attractive for the controlled release of active compounds. Utilizing supercritical CO_2 for impregnation provides several advantages, including the elimination of organic solvents, low-temperature operation, uniform distribution of active substances within the polymer matrix, avoidance of the drying process, minimal energy consumption and complete separation of the supercritical fluid at the end of the impregnation process.Starch aerogels were produced by drying starch alcogels, with alternating static and dynamic exposure to supercritical CO_2 over a period of 2 h 40 min. The resulting aerogels were subjected to batch-mode impregnation with thymol, carvacrol, and eugenol using supercritical CO_2 during 2 h. To examine the release kinetics of the active compounds, the impregnated aerogels were immersed in a phosphate-buffered saline solution at 37 °C for 72 h. The concentration of the active substances was determined using UV-Vis spectrophotometry. The active compounds release kinetics was described with Korsmeyer-Peppas, zero-order, Higuchi and first-order models. Remarkably, all three bioactive compounds exhibited controlled release over a 24-hour period, with maximum release percentages of 99.8 % for thymol, 88.3 % for carvacrol, and 99.6 % for eugenol. These results suggest that the developed starch aerogels, impregnated in the described manner, have the potential to serve as controlled delivery systems for thymol, carvacrol, and eugenol during a long period. Due to their properties, such systems could be used for manufacturing wound dressings.

1-5

Evaluation of the anti-inflammatory potential of *Paeonia tenuifolia* L. petal extract

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Paeonia tenuifolia L. is a perennial, herbaceous plant species, known for the medicinal value of all of its parts. This study is aimed at determining the anti-inflammatory activity of the petals from *P. tenuifolia* L. wild-growing in Gulenovci, Serbia. The extract was prepared using the maceration method, and methyl alcohol as the extraction solvent, after which the sample was filtered through a filter paper, and dried to a constant mass using a drying oven. The anti-inflammatory activity of the extract was assessed based on the inhibition of protein denaturation under the influence of elevated temperatures. *P. tenuifolia* L. petal extract (250–1000 µg/mL) achieved a significant *in vitro* inhibition of the bovine serum albumin (BSA) denaturation, in a dose-dependent manner. The obtained results were compared to a reference drug, ibuprofen (20-100 µg/mL). The petal extract showed the highest anti-inflammatory potential at a concentration of 250 µg/mL, with 80.07 ± 1.33% of inhibition, while the lowest level of inhibition was achieved at the highest tested concentration (54.33 ± 2.33%). This type of findings highlight the potential use of *P. tenuifolia* petal extracts in pharmaceutical and cosmetic industries, for the treatment of skin inflammation.

1-6

Comparison of model bacterial membranes of selected *Legionella* species

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Legionella bacteria, belonging to the *Legionellaceae* family, are ubiquitous in water and soil Gram-negative bacilli. These microorganisms are the intracellular protozoan pathogens and can infect human lung macrophages, due to the numerous mechanisms allowing them to replicate and survive in the host environment. The cell envelope structure, especially the qualitative composition and quantitative proportions of phospholipids (PLs), is crucial for virulence of *Legionella* bacteria. The external factors, such as the presence of exogenous choline in the culture medium, alter the PLs' composition, which directly affects the characteristics of the bacterial membranes. The aim of this study was to determine the physicochemical properties of model membranes (Langmuir monolayers) formed by PLs isolated from the *Legionella micdadei*, *Legionella dumoffii* and *Legionella gormanii* bacteria, supplemented or not with choline. The surface pressure-mean molecular area (π-A) isotherms were recorded during the monolayer compression using the computer controlled Langmuir trough. The results indicate that the membrane properties, such as molecular packing and ordering, degree of condensation or stability, differ significantly depending on the PL composition induced by choline addition to the medium for the above-mentioned bacteria species.

1-7

Study on interactions between the LL-37 peptide and model bacterial membranes

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Human cathelicidin (LL-37) is the antimicrobial peptide, expressed in macrophages, neutrophils and epithelial cells. The antibacterial activity of LL-37 towards both Gram-positive and Gram-negative bacteria results from electrostatic and Lifshitz-van der Waals interactions with the bacterial membrane. Therefore, the structure of the cell outer layer of these microorganisms is key factor for resistance to the peptide or its lethal effect. The main component of bacterial membranes are phospholipids (PLs), thus the peptide-cell interactions are dependent on the mutual proportions of these compounds, as well as their arrangement in the membrane. The aim of these studies was to analyze the influence of LL-37 peptide on model membranes of *Legionella* bacteria species differing in PLs' composition. PLs isolated from *Legionella micdadei*, *Legionella dumoffii* and *Legionella gormanii*, cultured on a medium with (+choline) or without (-choline) choline were used to prepare model membranes, employing the Langmuir monolayer technique. The surface pressure-mean molecular area (π-A) isotherms were registered during the monolayer compression, for both pure PL monolayers and those with the LL-37 addition. The results indicated that the various PLs' compositions of analyzed species had a significant impact on the antimicrobial peptide activity. The *L. gormanii* membranes were found radically less resistant to the LL-37 action in comparison to those of the *L. micdadei* or *L. dumoffii*. Moreover, the choline presence increased the bacteria susceptibility to the peptide.

2-1

Activity of resveratrol nanobelt-like particles against *Pseudomonas aeruginosa* biofilms

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Biomaterial implant contaminations are the most common nosocomial infections. Especially complicated to treat are the ones caused by microbial biofilms. Biofilms are structures comprised of surface-attached cells protected by self-produced polymeric matrix, and are present in more than 80% of persistent infections. *Pseudomonas aeruginosa* biofilms are exceptionally difficult to resolve, due to high capability of this bacteria for producing biofilm and acquiring antibiotic resistance. In order to prevent biofilm formation and reduce the unnecessary use of antibiotics, various nanomaterials and natural antibiofilm agents are being given more attention in tissue engineering in the last decade. Bioactive polyphenolic compounds have potential for use in biomaterials as multifunctional additives. Among polyphenols, resveratrol is one of the most known, but its' use is limited by low bioavailability and difficulty of delivery. In our previous research, we created resveratrol nanobelt-like particles of shape convenient for handling and scaffold coating. Here we investigated their potential for inhibiting growth and biofilm formation of several strains of *Pseudomonas aeruginosa*. Microdilution assay and resazurin staining, as well as agar plating were used to estimate minimal inhibitory and minimal bactericidal concentration. MTT method was performed to more accurately measure the influence of various concentrations on bacterial growth. Crystal violet assay and RT PCR analysis determined the amount of biofilm formation and effect on gene expression. The effect varied among the strains, but most of the tested concentrations, including the lowest ones, led to at least 40% of inhibition of biofilm formation. Concentration of 800 μg/ml achieved almost 90% inhibition of biofilm formation in ATCC reference strain, indicating potential of this material for further use for such purpose in biomaterial design.

2-2

Cultivation of bone cells from different sources in a biomimetic 3D *in vitro* bone model based on alginate scaffolds and a perfusion bioreactor

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3D *in vitro* cell culture models provide a physiologically relevant environment for maintaining cell physiological functions and characteristics. In fact, 3D culture models are an innovative approach as the concept of these models itself offers numerous advantages over traditionally utilized cell monolayers and animals in a wide range of applications including tumor research, anti-tumor drug screening and tissue engineering. The aim of our research was to develop a 3D *in vitro* bone model based on macroporous composite alginate scaffolds with incorporated hydroxyapatite particles (2 wt.% alginate, 2 wt.% hydroxyapatite) and a perfusion bioreactor. Scaffolds resemble bone in terms of its structure and composition whereas a perfusion bioreactor creates biomimetic conditions by enhancing the mass transport of nutrients and providing cells with hydrodynamic shear stresses. This model was used for the cultivation of cells from different sources: osteosarcoma tumor cells (murine K7M2-wt and human U2OS cell line) and mesenchymal stem cells (human bone marrow-derived cell line and primary cells). Cells were seeded onto the scaffolds and then cultivated in perfusion bioreactors under the same conditions (medium flow rate 0.27 cm^3/min, superficial velocity 40 μm/s) for 7 days. Cells cultivated within scaffolds under static conditions served as a control. All cell types adhered to the scaffolds comprising cell seeding efficiency of >90% and retained their *in vivo* morphology. Concerning tumor cells, perfusion conditions were more favorable for K7M2-wt cells which exhibited the main characteristics of tumor cells. Perfusion also supported both mesenchymal stem cell types regarding viability, proliferation, and self-arrangement into aligned structures. In conclusion, our 3D *in vitro* bone model was shown to be promising for both bone tumor and tissue engineering.

2-3

Tuneable alginate hydrogel microfibers to support 3D cultures of cancer cells requiring different culture media

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Growing recognition of the importance of the role of tumour microenvironment in behaviour and response of cultured cancer cells to therapy is shifting the cancer research from traditional two-dimensional (2D) monolayer cultures towards more *in vivo*-like three-dimensional (3D) cancer models. However, each cancer cell line is different and requires adequate culture medium to support cell growth and specialized cancer properties. Here we propose a simple, tuneable 3D cancer model based on alginate hydrogel microfibers and cancer cells, designed to support cancer cell cultures that require different culture media. Two different cancer cell lines were used: murine osteosarcoma K7M2 wt, which is grown in Dulbecco's Modified Eagle Medium (DMEM), and human non-small-cell lung NCI-H460, which is grown in Roswell Park Memorial Institute (RPMI) medium. Ca^{2+} is most commonly used for gelation of alginate, but Ca-alginate hydrogels are very unstable in RPMI. To address this problem, Ba^{2+} can be used instead of Ca^{2+} for gelation of alginate. Microfibers were produced by simple extrusion: cell-alginate suspension (4×10^6 cells/ml, 2 wt. % Na-alginate) was manually extruded through a 25G needle into the gelling solution containing either 0.18 M Ca^{2+} or 0.045 M Ba^{2+}. The obtained microfibers were transferred to T-25 flasks and cultured for 7 days. Histological analysis or live/dead staining of osteosarcoma cells cultured in Ca-alginate microfibers and lung cancer cells cultured in Ba-alginate microfibers showed that the microfibers supported cell viability and formation of cellular aggregates in both cases. Also, both 3D cultures were validated in anticancer drug testing by using 0.25-20 μM doxorubicin (osteosarcoma cells) or 0.5-50 μM cisplatin (lung cancer cells). The results indicated higher resistance to the applied drugs in 3D cultures compared to 2D, demonstrating the potentials of the proposed 3D cancer model for anticancer drug screening.

2-4

Influence of synthesized calcium phosphate-based nanomaterial on proliferation of dental pulp stem cells in various *in vitro* conditions

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Dental pulp stem cells (DPSCs) are mesenchymal stem cells that are easy to obtain from any kind of discarded teeth and have the ability to differentiate into several cell types which makes them very popular in researches regarding regenerative dentistry. In recent years, there is an emerging trend of the use of nanomaterials in medicine and dentistry and they become very attractive tool for the treatment of bone tissue defects but also as a carriers of bioactive molecules. Before clinical application, thorough preclinical studies should be conducted regarding biocompatibility and biofunctionality of synthesized nanomaterials. Therefore, the aim of this study was to examine the influence of synthesized nanomaterial, biphasic calcium phosphate coated with poly-D,L-lactide-co-glycolide (CP/PLGA), on the proliferation of DPSCs during osteogenic differentiation in cell culture *in vitro*. We isolated the cells from the mature healthy teeth by outgrowth of the cells from undigested pulp pieces during culturing, in standard cell culture conditions. Cells were incubated with two concentrations of CP/PLGA nanoparticles in standard cell culture media and media for osteogenic differentiation. Cell proliferation rate was assessed using MTT and Crystal violet test after one, three and seven days of cell culturing. The results showed time- and concentration-dependent differences in DPSCs proliferation in the presence of nanomaterial. Differences in cell proliferation were noticed between osteogenic and standard cell culture media as well as in results obtained by performed tests. Increased cell proliferation was observed over time in both media but this effect was dependent on nanomaterial concentration. Calcium phosphate-based nanomaterials and DPSCs, based on observed cell-materials interactions, could be a promising tool in bone tissue regeneration and further studies using *in vitro* as well as *in vivo* models should be conducted to fully unravel all of its potential.

Acknowledgement: This study was supported by the Ministry of Science, Technological Development and Innovations of the Republic of Serbia (Contract No. 451-03-47/2023-01/200113).

2-5

Comparative analysis of subcutaneous tissue reaction to different collagen membranes with or without addition of blood

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Collagen membranes of different origin, derived from various tissue compartments and obtained by various manufacturing processes are widely used in soft and bone tissue engineering. There is a wide range of architectural variations, porosity levels, biodegradability, and other physicochemical characteristics of membranes that is largely influenced by manufacturing process and origin. When applied, collagen membranes usually come into contact with blood coming from the defect site which raise the need for analysis of tissue reaction to the membranes soaked with blood. Investigation of this aspect is crucial considering the impact of blood presence on tissue-biomaterial interaction in clinical practice. Thus, the aim of this study was to compare tissue response to implanted collagen membranes obtained from the same animal species, but from different tissue compartments, with or without addition of blood. We examined two collagen membranes: membrane derived from porcine pericardium and membrane derived from porcine dermis, with or without addition of blood, in BALB/c mice subcutaneous implantation model and evaluated tissue reaction by histological methods and scanning electron microscopy 3, 10, and 30 days after implantation. Both membranes, in both experimental setups, revealed suitable integration pattern with the surrounding tissue. However, noticeable differences in tissue response, including patterns of cell attachment and infiltration as well as dynamics of new collagen production and bioresorption of membranes was observed between all experimental groups at all examined time points. These findings suggest that enriching with blood may impact the tissue reaction to the collagen membranes. Moreover, this correlation depends on the membrane's properties which are closely tied to the origin of membranes and process of production.

Acknowledgement: This study was supported by the Ministry of Science, Technological Development and Innovations of the Republic of Serbia (Contract No. 451-03-47/2023-01/200113).

2-6

Study of the properties of oxidized cellulose plus bioglass as a new bioink for application in regenerative medicine

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There are numerous researches on biomaterials, with the association of some natural and synthetic polymers and ceramic materials, for the development of hydrogels and bioinks, in an attempt to develop a biomaterial that is resistant, biocompatible and bioactive, which forms a bond with the host tissues and promotes tissue regeneration. The purpose of this work is to produce a bioink based on a hydrogel of chemically oxidized cellulose and bioglass (58S) for application in regenerative medicine. In this study, the chemically oxidized cellulose gel was obtained from a natural source of sugar cane bagasse, the material was washed, bleached, chemically treated with the TEMPO reagent and sonicated to obtain a viscous gel. Tertiary bioglass (58S) obtained by the sol-gel method was used because it showed better viability and cell proliferation. Chemically oxidized cellulose and bioglass (58S) were combined to form the composite. The results obtained were promising for characterizing the composite as a bioink. In this way, the rheological tests characterized the composite as a hydrogel. Subsequently, to form the bioink, bone cells (MG-63) were inserted inside the hydrogel. The results of the cell tests showed that after ten days the cells were still viable, as well as DAPI showing that the cells were inserted inside the material, characterizing it as a bioink and the Alizarin Red test showing the ability to form a mineralized matrix.

3-1

Nanofabrication and characterisation of magnetic Fe_3O_4 nanostructures for potential environmental and biomedical applications

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Magnetic iron oxide nanomaterials, which enable a multitude of uses, are given special focus in the fields of biomedicine and environmental protection. The detection, sorption, and/or degradation of inorganic (lead, chromium, arsenic, and cadmium), organic (dyes, pharmaceuticals, pesticides, phenols, and benzene), and biological (viruses and bacteria) pollutants can all be effectively accomplished with the use of magnetic nanoparticles. Magnetic iron oxide nanomaterials are in particular focus for use as hyperthermia media in cancer treatment and as magnetic resonance imaging (MRI) contrast agents. The possibility of magnetic separation of such materials, due to their essential properties under the influence of an external magnetic field, reduces production costs and also prevents the production and accumulation of toxic waste. Among the many metal oxide nanomaterials, magnetite (Fe_3O_4) and maghemite (γ-Fe_2O_3) are currently the only two magnetic materials approved by the US Food and Drug Administration (FDA) for human use as iron deficiency therapeutics and as contrast agents for MRI. Here, we synthesized nanoparticles of magnetite (Fe_3O_4) by the method of reduction-precipitation and characterized. Additionally, potential binding of brilliant green dye on Fe_3O_4 and construction of innovative magnetic composite was investigated. The physicochemical features were explored using X-ray diffraction (XRD), Fourier-transform infrared spectroscopy (FTIR), and field emission scanning electron microscopy (FESEM). XRD analysis confirms formation of the crystal phase of magnetite. The presence of magnetite nanoparticles is shown by typical groups for the peaks of iron compounds at a lower wavelength ($\leq$ 700 cm^{-1}) that are characteristic of the Fe-O bond. Morphological analyzes with FESEM showed that magnetite is a composite of nanospheres and nanorods that provide a large surface area. Dye binding study was performed using UV-visible and FTIR spectrometer.

3-2

Peroxidase-like activity of chitosan modified magnetic nanoparticles

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Today, magnetic nanoparticles (MNPs, such as Fe_3O_4) as a type of nanoscale materials are of great interest in magnetic resonance imaging, magnetic hyperthermia, and targeted drug delivery due to their extremely small size (up to 100 nm), low toxicity, superparamagnetic properties, biocompatibility, biological degradation, large surface area per unit volume, and the ability to be excreted from the body naturally. In addition, MNPs have an intrinsic peroxidase-like activity, which makes it possible to use them as a tool for detecting and visualizing tumour tissue. Furthermore, MNPs have almost unchanged catalytic activity in a wide range of temperature and pH and are also significantly more stable compared to natural enzymes peroxidases.-MNPs can be easily synthesized in large volumes and at relatively low cost. This allows magnetic nanoparticles to be used as natural peroxidase enzymes or to replace natural peroxidase enzymes in applications based on the detection of hydrogen peroxide. In our work, we studied the influence of the concentration of the stabilizing material on the peroxidase-like activity of MNPs. MNPs were prepared MNPs by the coprecipitation method followed by their coating with chitosan (a bioactive polymer) to obtain stable chitosan-modified magnetic nanoparticles (Chit-MNPs). The comprehensive physicochemical characterization of unmodified MNPs and Chit-MNPs was carried out to determine their structure, morphology, and magnetic properties. The peroxidase-like activity of uncoated MNPs and Chit-MNPs was also investigated by oxidation of the chromogenic substrate N, N-diethyl-p-phenylenediamine sulfate (DPD) with hydrogen peroxide. Unmodified MNPs and Chit-MNPs were found to be able to activate H_2O_2 and oxidize DPD to a purple product with an absorption maximum of 550 nm. Furthermore, when increasing the concentration of imposed chitosan on the surface of magnetic nanoparticles (for the lowest H_2O_2 concentration of $1*10^{-3}$ M), a decrease in catalytic activity was detected, i.e. even a small amount of bound chitosan on MNPs reduces the peroxidase-like activity of MNPs.

Acknowledgement: This work was supported by the Slovak Research and Development Agency under the contract no. DS-FR-22-0037, and Slovak Grant Agency VEGA 02/0049/23.

3-3

Towards new approaches for Ultraviolet sterilization of MXenes

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

Acknowledgement: This research received support from the Horizon Europe MSCA-2021-SE-01 project 101086184 MX-MAP and Ukraine MES grant “The mechanisms of MXene interactions with biological systems” ID: 0122U000784.

3-4

Atomic and molecular spectroscopic analysis of chemically treated pig shoulder bone: Possible application in forensics

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Chemical treatment of pig shoulder bone by hydrochloric, hydrofluoric, and acetic acid (0.1 and 1 M) was monitored by FTIR, Raman and LIBS spectroscopy. Fourier deconvolution of FTIR spectra performed in the amide I (1700-1600 cm^{-1}), phosphate (900-1200 cm^{-1}), and carbonate (500-650 cm^{-1}) region indicated the presence of different components in the bone sample, depending on the environment and its concentration. Based on FTIR and Raman spectral data bone samples were characterized by mineral-to-matrix ratio (MM), crystallinity index (CI), and carbonate-to-phosphate ratio. Intensities of calcium ionic-to-atomic spectral lines (364.441 nm and 370.603 nm respectively) obtained from LIBS spectra were used for the estimate of bone hardness. The intensity ratio of phosphorous-to-carbon (P/C) lines was correlated with MM ratios obtained from FTIR spectra. Comparison of FTIR, Raman and LIBS data were in rather good agreement. The results suggest that an increase in acid concentration primarily affects the intensity and the structure of the phosphate band as the phosphate content is more susceptible to demineralization. The highest level of demineralization (the lowest MM), for both concentrations, is obtained for hydrochloric acid, which indicates a greater ability of strong acids to demineralize the inorganic matrix. CI values obtained from Raman spectra (for 0.1 M acid solutions) are in accordance with Ca II/Ca I ratio values obtained from LIBS spectra. Also, MM values obtained from the FTIR spectra are in good agreement with the P/C ratio obtained from the LIBS spectra. These preliminary data motivate further experiments in the field of chemical modifications due to the effects of acids and implications of these processes in forensics.

3-5

Application of polylactide (PLA) biomaterial in various fields of medicine

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Polylactide (PLA) or polylactic acid is a biodegradable and biocompatible biomaterial obtained from lactic acid, extracted from sugar cane or corn starch. Due to its biocompatibility, after application, it will cause a minimal reaction of the organism, and by virtue of its biodegradability, it will facilitate postoperative recovery because there is no need for its removal. It is often in combination with other compounds to fulfill the requirement about properties which implant need to have. In this review, this will be described in which areas of medicine apply this biomaterial and in which forms. We will see that this material can be made various implants such as surgical sutures, tiles, screws, coatings, capsules and tissue matrices and that this application is especially important in surgical branches of medicine.

3-6

The material for the treatment of periapical granulomas

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The etiology of granulomatosis is diverse. There are infectious, non-infectious and unidentified granulomasThe pathogenesis of apical or periapical granulomatosis are ambiguous. There are two conditions have necessary for the development of granuloma: the presence of substances capable of stimulating the system of monocytic phagocytes and the reactivity of the organism. Apical or periapical granuloma have well-defined inflammatory focus of growing granulation tissue, soldered to the apex of the tooth root. The growth of granulation tissue occurs in response to bacterial or drug intoxication. The neoplasm does not dissolve on its own, and therefore requires treatment using specific endodontic materials. Morphologically, apical or periapical granulomas are divided into three types: simple, complex, combined. For the treatment of the periapical process, a number of requirements are put forward for materials: 1. minimal toxicity, 2. bactericidal activity, 3. plasticity, 4 radiopacity, and others. There is a need to create an endodontic filling material for root canal obturation for the treatment of various types of granulomatous periapical inflammation. Development of complex composite materials loaded with AgNPs for specific application in dentistry and their structural. We have studied teeth samples for organical and mineral content. Based on the study results, we can conclude that the periapical granuloma depend of bacteriaon the teeht root canal. We assume that the bacteial contananation leve in the root canal is cut for AgNPs agent.

4-1

Bentonite modified with cationic surfactant as promissing adsorbent for carbamazepine

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Numerous chemical compounds present in natural waters and wastewater are resistant to conventional water treatments and persist in treated effluents. Among these substances, pharmaceuticals, due to their widespread use, raise special concern due to their potentially harmful effects on human health especially when they reach drinking water. One of the most efficient technique for removal of pharmaceuticals from polluted water is their adsorption on various adsorbents, such as activated carbons, clays (kaolin, bentonite, etc.) and zeolites. In this study, the potential of modified bentonite for removal of carbamazepine, a pharmaceutical with anticonvulsant and mood-stabilizing properties, was investigated. The natural bentonite from Šipovo deposit, Bosnia and Herzegovina, was modified with the cationic surfactant Arquad®2HT-75 in amounts equivalent to 50% and 100% of the bentonite's cationic exchange capacity. Characterization of prepared samples by Fourier-transform infrared spectroscopy and Simultaneous Thermal Analysis, confirmed presence of surfactant in modified bentonites. Results on carbamazepine removal by modified bentonites showed that its adsorption increased with increasing of the amount of surfactant as well as with increasing of the initial pharmaceutical concentration. The highest adsorption of carbamazepine was achieved with bentonite containing the highest amount of surfactant. Since the natural bentonite has no affinity to remove carbamazepine, these findings suggest that modified bentonite is a promising adsorbent for its removal from contaminated water.

4-2

Assisted phytostabilization of Pb-contaminated soil using brushite-metakaoiln geopolymer materials and *Festuca rubra*

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Lead (Pb) is one of the most common environmental pollutants and high concentrations of this element can cause numerous symptoms of phytotoxicity. Inorganic amendments immobilize metal/metalloid ions and reduce their bioavailability in the soil by increasing pH or by adsorbing them. Adsorption mechanisms include chemical precipitation, ion exchange, and crystal growth. In this experiment, geopolymer materials were newly synthesized from a natural raw kaolinite clay with 2, 4, and 6 wt % (GPB2, GPB4, and GPB6) of pure brushite addition. Previous research has shown that brushite-metakaolin geopolymer materials can be successfully synthesized and that they have significant efficiency in removing lead ions from aqueous solutions. Plant samples were grown under controlled conditions in eight different series using commercial substrate and seeds. Four series contained lead-contaminated soil and were treated with brushite-metakaolin geopolymer materials, while the other four series, which contained uncontaminated soil, were also treated with brushite-metakaolin geopolymer materials and served as control series. The plant samples were taken after six weeks. Lead concentrations in the different plant and soil samples were analyzed using an absorption spectrophotometer (AAS). BCF, BAF and TF were calculated from the results obtained. Moreover, physiological and biochemical experiments were carried out and total antioxidant capacity, total phenols, free proline and photosynthetic pigments (chlorophyll a, chlorophyll b, and carotenoids) contents were measured in different plant samples. The results show different responses to metal/metalloid toxicity in the control and treated plant samples, confirming that there is a significant influence of brushite-metakaolin geopolymer materials on the phytostabilization efficiency of *Festuca rubra*. Phytostabilization is an eco-friendly and cost-effective technique that allows the metals/metalloids to be immobilized in the soil by plants, preventing their migration into the surrounding ecosystem and reducing the chances of them entering the food chain.

4-3

Improvement of sorption properties of natural clay pyrophyllite by ultrasonic treatment

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Pyrophyllite, a naturally abundant clay material, exhibits remarkable physicochemical characteristics. Its minimal electrical and thermal conductivity, low expansion rate, strong mechanical properties, and outstanding heat resistance make it a valuable resource across diverse industries. Pyrophyllite finds applications in sectors such as paper and plastic manufacturing, brick production, ceramics, cosmetics, rubber processing, and wastewater treatment. Furthermore, its versatility extends to the production of ceramic membranes for efficient water filtration. This paper presents the characterization of natural pyrophyllite ore subjected to ultrasonic treatment at varying time intervals. The ultrasonic treatment aims to eliminate hard phases such as quartz and calcite within the ore, thereby improving its sorption capabilities. The treated samples were subjected to analysis using SEM and XRD techniques. Morphological and structural analysis revealed that as the duration of ultrasonic treatment increased, the proportion of hard phases in the sample decreased. Additionally, this study evaluated the sorption properties of pyrophyllite. A comparative analysis was conducted between a raw clay sample containing various admixtures and a sample that underwent a 30-minute ultrasonic treatment. The sorption of a methylene blue solution after 24 hours in water was assessed, with UV-Vis analysis revealing that the efficiency of the sonically treated pyrophyllite exceeded 97%, whereas the raw ore exhibited approximately 89% efficiency over the same duration. These findings suggest that the removal of hard phases from pyrophyllite ore enhances its sorption properties.

4-4

The impact of thermal treatment on spent coffee grounds for chlorpyrifos removal from water

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Coffee is one of the world's most beloved beverages, with an annual production exceeding 10.5 million tons. However, the extensive generation of spent coffee grounds (SCGs) raises environmental concerns when carelessly disposed of. Also, the growing issue of pesticide contamination in water and food poses an environmental challenge. Given the hazardous nature of pesticides and their potential to inflict severe health consequences, it is important to understand how these compounds interact with biowaste materials. In this study, the spent coffee grounds are thermally treated at 400, 650, and 900 °C and named C400, C650, and C900, respectively. The synthesized materials and the initial SCG have been characterized using SEM, EDX, and FTIR. The kinetics of chlorpyrifos (CHP) adsorption on these materials has been investigated using pseudo-first-order (PFO), pseudo-second-order (PSO), Elovich, and intraparticle diffusion kinetic models. Adsorption experiments were done at three temperatures (25, 30, and 35°C), and the obtained experimental results were analyzed using non-linear Freundlich, Langmuir, Temkin, and Dubinin-Radushkevich isotherm models. Thermodynamics of the process has also been investigated. The results showed that the CHP adsorption process on all four materials fits equally well in both PFO and PSO and that the equilibrium time is 400 min. Isotherm study of adsorption on all three temperatures shows very good fitting in both Freundlich and Langmuir isotherm models. Langmuir isotherm model revealed that the maximum concentration of CHP that can be adsorbed by 1g of materials (q_{max}) is 2.31 mg g^{-1}, 19.43 mg g^{-1}, 4.67 mg g^{-1}, and 10.98 mg g^{-1} for SCG, C400, C650, and C900 respectfully. Thermodynamic parameters revealed that the adsorption of CHP on all investigated materials is a spontaneous process. By increasing the adsorption temperature, the q_{max} value increases for SCG, C650, and C900, indicating that the process is exothermic, and decreases in the case of C400, indicating that the process is endothermic.

4-5

Applying carbon materials derived from cellulose for the removal of malathion and chlorpyrifos in food processing

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The growing use of pesticides to enhance food production leads to their presence in food samples, necessitating the creation of efficient methods for their elimination. This study demonstrates that activated carbon materials derived from cellulose can effectively remove malathion and chlorpyrifos from liquid samples, even when found in complex matrices. Adsorbents were carbonized at 850 °C and activated in the temperature range between 670 and 870 °C where activation time was from 30 to 180 min and CO_2 flow rate from 10 to 80 L h^{-1}). After that, materials were characterized in terms of physical and chemical properties using SEM, EDX, BET, FTIR, Raman, and Zeta potential. The synthesized materials were tested by removing malathion and chlorpyrifos from lemon juice and mint ethanol extracts. The results showed that these materials remove these pesticides to a high degree. Furthermore, some of the developed adsorbents exhibit the ability to selectively remove chlorpyrifos in the presence of malathion. These selected materials remain unaffected by the intricate compositions of real samples. Additionally, the adsorbent can be regenerated at least five times without significant performance degradation. Our findings propose that the adsorptive elimination of contaminants from food can substantially enhance food safety and quality.

4-6

Quality control of gas flow proportional counter for beta spectrometric determination of ^{90}Sr

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In the Radiation and Environmental Protection Department, Vinča Institute of Nuclear Sciences, the validated radiochemical analytical method for ^{90}Sr determination in environmental samples is used. The Laboratory for Radiation Measurements within mentioned Department is accredited according to ISO/IEC 17025. The activity of ^{90}Sr is determined indirectly, by beta counting of its daughter product ^{90}Y, and after established radioactive equilibrium during 18 days from the moment of ^{90}Y radiochemical separation. Beta spectrometry by gas flow proportional counter Thermo Eberline FHT 770T is used for detection of ^{90}Sr activity in investigated samples. In order to assure the reliability of the measurement results in accordance with Standard ISO/IEC 17025:2017, quality assurance and quality control (QA/QC) corresponding procedures need to be applied. For this purpose, activities ought to be planned in a systematic manner as described in the quality control documentation. The efficiency calibration of the detection system needs to be performed in a proper manner. The calibration of the detector for beta counting is performed using the Sr-90 certified radioactive standard point source (9031-OL-335/11, produced by Czech Metrology Institute) which is traceable to Bureau International des Poids et Mesures (BIPM). As low-level measurements require strict QA/QC requests, the accuracy and reproducibility of measurement systems must be verified periodically. A regular internal quality control of the gas flow proportional counter is performed once a week. Quality control activities include the background measurement and checking of efficiency using adequate radioactive standard source. The measurement values are recorded and verified if they are within the acceptance limits. The obtained results together with acceptance limits during the period of 3 months are graphically presented in control charts. The acceptance limits are set to be ±2σ and ±3σ in relation to the calculated mean value and standard deviation. The results of QC verification within ±2σ are considered to be satisfactory, those within ±3σ are warning, while those that exceeding ±3σ indicate that there is a problem with the measurement system. Consequently, the analysis of causes and design, as well as the application of corrective measures is needed.

5-1

Application of thin-layer chromatography in the assessment of lipophilicity of chloroacetamide derivatives

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Chloroacetamides are important herbicides that are widely used in agriculture, mostly for weed control. In addition to being used in agriculture, these compounds have remarkable biological properties, such as analgesic, antipyretic, antimicrobial, bactericidal, hypoglycaemic, and antitumor. Today, much attention is devoted to studying and establishing the connection between the structure of a molecule and its properties. To establish the aforementioned dependence, parameters called molecular descriptors are applied. The most commonly applied molecular descriptor used to assess the potential biological activity of a compound is lipophilicity. In this study, lipopilicity for chloroacetamide was determined experimentally, by using reversed phase thin-layer chromatography, RPTLC C18/UV_{254s} in the mixtures of water and two organic modifiers, separately, as well as computationally by using software packages. The dependence between the chromatographic parameters (R_M^0 and m) and the software-derived values of the standard measure of lipophilicity (log$P$), as well as the selected ecotoxicity parameters, was examined by applying linear regression analysis. The obtained mathematical models indicate the reliable application of the chromatographic parameters, R_M^0 and m in the assessment of the studied chloroacetamide derivatives lipophilicity and ecotoxicity.

5-2

Microplastics in urban soils of Belgrade: Abundance and potential sources

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Microplastics (MPs), the long-lasting anthropogenic contaminant omnipresent in the environment, have become a threat to ecosystems' function and living organisms' health, potentially harming the food chain globally. The presence of MPs emerged on a worldwide scale, while the evidence of microplastic particles is already being detected in human tissues. Terrestrial environments are sinks for plastic deposition and are one of the main routes of MPs reaching the groundwater and water bodies. In this regard, urban soils could significantly contribute to overall plastic pollution even though it have been mostly neglected by the research investigations carried out so far. Herein, we investigated MPs abundance in the soils of Belgrade, a city located in the northeast of Serbia, the capital and the most populated city in Serbia. Two sampling points chosen to represent the pollution gradient were the city center zone, close to the highway (BG1), and Košutnjak, the urban forest area around 7 km distant from the center (BG2). MPs extraction was performed using a density separation method, by saturated NaCl solution (1.2 g cm^{-3}). Before extraction, soil organic matter was digested by 30% H_2O_2. Found average concentration of MPs was 400 items per kg of dry soil sampled in BG1. Soil from Košutnjak contained no MPs according to our findings. MPs abundance found in sampled soils from Belgrade is in agreement with previous reports analyzing urban areas. Isolated plastic particles were identified and counted using a polarizing microscope (Carl Zeiss Jena Pol-U). All found items were white/transparent fragments, characterized afterward by ATR-FTIR spectroscopy using a Thermo Scientific Nicolet iS50 spectrophotometer. Detected polymer types were polystyrene (PS) and phosphorylated cardanol prepolymer (PCP), suggesting the insulation, packing, and rubber materials as potential pollution sources. Transportation, overload of customer goods and packaging, construction, and building activities are the prevailing anthropogenic origins of MPs accumulation in urban environments. Further investigations will aim to reveal the relations between MPs and other pollutants and the potential impact on soil biota.

5-3

Microbial degradation of terephtalic acid as a PET-derived compound

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Polyethylene terephthalate (PET) is a plastic material that poses a significant global concern due to its durability and resistance to degradation. One effective method for minimizing PET waste is through microbial degradation, resulting in the production of ethylene glycol and terephthalic acid (TA). Terephthalic acid, as a PET monomer, holds promise as a model compound for further exploration into PET plastic degradation and valorisation. In this study, degradation of TA is monitored by Micro-Oxymax Respirometer (Columbus Instruments, USA). It's used in a 'Closed Loop Measurement Method' mode and during the 12 days experiment it measured changes in oxygen and carbon dioxide concentration. The gas flow was 500 mL/min and concentration of gases were measured every 10 h. Microorganisms (single and in consortium) were inoculated in MSM medium that contains 0.025% (w/v) TA as carbon source. The microorganisms used were previously isolated from contaminated environment. Results showed higher oxygen consumption and carbon dioxide production by *Rhodococcus sp.* and consortia which contained *Enterobacter* sp., *Bacillus* sp. and *Pseudomonas* sp. The present study indicate that studied microorganisms with higher metabolic activity in the presence of TA are promising candidates for further valorization of PET-derived monomers.

5-4

Immobilization of nickel ions into stable crystal structures as a promising way for their removal from wastewater

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Environmental pollution is increasing day by day due to industrial activities. Heavy metals are pollutants of special concern due to their toxicity, persistence, and bioaccumulation in nature. Nickel is a heavy metal that is mostly used in industries because of its anticorrosion behavior. As a consequence, nickel ions are present in the wastewater from mining, electroplating, battery manufacturing and metal finishing industries. Nickel ions are non-biodegradable, and as such, they are present in surface water. Their high concentrations can have a dangerous impact on human health and aquatic life. In this work, a promising method for the removal of Ni ions from wastewater and their incorporation into a stable crystal structure was described. Ni-exchanged form of LTA zeolite was prepared by the standard procedure of ion exchange. After the ion exchange, powder samples were heated at temperatures of 900 to 1300 ºC in order to obtain a stable crystal structure of Ni-spinel, $NiAl_2O_4$. XRF analysis was used to study ion exchange efficiency. Characterization of raw as well as thermally treated powder samples of Ni-exchanged LTA zeolite was conducted by XRPD, DTA/TG, FT-IR and SEM analysis.

5-5

Particularities of the isolation of rare earth elements from mechanochemically modified brown coals

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Rare earth elements (REE) include 17 elements of the periodic table of chemical elements. The demand for the extraction of rare earth elements is growing every day, because they are currently used in various areas of our lives, such as electronics, medicine, catalysts etc. Deposits of rare earth mineral ores are distributed unevenly around the world, and the existing stock of elements for production becomes insufficient due to the growing demand of modern society for new gadgets. Hence, an urgent task facing researchers around the world is the development of methods for concentrating rare earth elements from alternative sources. One such sources is brown coal. To simplify the problem of extracting rare earth elements from coals, a method of mechanochemical modification was carried out without reagents and with the addition of humic acids in mechanochemical activators of the planetary type AGO-2. Mechanically activated carbons are characterized by increased reactivity during subsequent treatment with reagents. The purpose of this work was to study the dynamics of changes in the concentration of rare earth elements in brown coals during mechanochemical activation with the addition of humic acids. To achieve this goal, suitable samples were selected: Itatsky coal (Kansk-Achinsk coal basin, Russia), Azeysky coal (Eastern Siberia, Russia), Vanchin coal (Primorsky Territory, Russia), «Special» coal (Pavlovskoye deposit, Russia).To study the main phases present in coal, X-ray diffraction patterns were obtained using Bruker D8 Advance XRD diffractometer using Cu-Kα radiation. The macrocomposition of the samples was studied using a Hitachi TM-1000 scanning electron microscope. The elemental composition of all coals was studied using a ICP-MS method onan Agilent 7500a quadrupole mass spectrometer (Agilent Technologies, USA).It was found that Vanchin and Spets coals are characterized by a high content of rare earth elements of 2456 g/t and 150 g/t, respectively. Itatsky and Azeysky coals have a low REE content of 24 g/t and 968 g/t, respectively.

Acknowledgement: The study was supported by the Russian Science Foundation grant № 22-73-00192.

6-1

Quinuclidine thiosemicarbazone crystal structure determination: Quantum insights via Hirshfeld atom refinement and intermolecular interaction energies

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Crystal structure of quinuclidine thiosemicarbazone was determined using single crystal X-ray diffraction. During crystal structure refinement stage, conventional independent atom model (IAM) was used, as well as quantum crystallographic approach through Hirshfeld atom refinement (HAR). Two HAR approaches were tested, differing in the treatment of crystal filed simulation. In the first strategy, wavefunction was obtained for the central molecule and four additional molecules involved in hydrogen bonding. In the second strategy, wavefunction was obtained for the central molecule which was placed in simulated crystal field of point and dipole charges located at positions of the surrounding molecules' atoms. In spite of the fact that HAR was performed with suboptimal diffraction data, which was collected in a routine fashion (standard resolution of d_{min} = 0.8 Å and room temperature), a significant improvement in the resulting geometry and refinement statistics was obtained when compared to the IAM model. HAR resulted in lower R values (2.04%; 2.06%), compared to R=2.94% obtained with IAM refinement. Additionally, during HAR the positions and displacement parameters of all H atoms were successfully refined freely. The mean values for N–H (0.999 Å; 0.993 Å) and C–H (1.081 Å; 1.080 Å) bond lengths are close to (within ±0.01 Å) standard values obtained with neutron diffraction (N–H=1.015 Å; C–H=1.089 Å). Results obtained indicate that HAR could yield significantly improved structural parameters of crystal structures even from routine data collection practices, which advocates its general use in small molecule crystallography. Intermolecular interaction energies were calculated with *CrystalExplorer* and *PIXEL*. Data obtained with both methods are in good agreement. The hydrogen bonded dimer with the highest interaction energy (−47 kJ mol^{-1}) is predominantly influenced by electrostatic energy contributions. The second strongest interaction (−43 kJ/mol), also mediated through a hydrogen bond, exhibits an approximately equal contribution from dispersion and electrostatic energies. Additionally, several dispersion interactions with an average energy of −15 kJ mol^{-1} are observed. In summary, the molecular packing in the crystal is of the framework type, from the energetic perspective.

6-2

Computational modeling vs. experimental analyses of the energetic performance of pyrotechnic mixtures and explosives

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Energetic materials like explosives, composite rocket propellant and pyrotechnic compositions are used for different kinds of weapon systems. When initiated they transform their chemical energy throughout complex thermodynamical processes like combustion, deflagration or detonation. To achieve desired effect all of these processes must be strictly controlled. To ease work and achieve the desired effect faster, the first step when it comes to developing a new system is the theoretical modelling of combustion/explosion parameters. One of the most important parameters when it comes to combining different kinds of energetic materials in a pyrotechnic train is the value of heat of explosion/reaction. The heat of an explosion is defined as the amount of heat released through the combustion of 1 g of energetic material in an inert atmosphere. This paper focuses on a competitive analysis of theoretical vs experimental values of heat of explosion and reaction of selected energetic compositions. Theoretical values were calculated with thermodynamic code EXPLO5. The experimental values of energetic potential were measured with the isoperibolic IKA-Calorimeter C 2000 model. The experiments were performed in an atmosphere of an inert gas argon. Several compositions of explosives and pyrotechnic compositions were used for calculations and experiments. The study presented here indicates that theoretical modelling of explosive/combustion processes can be a helpful tool in the prediction of the energetic performance and in further ammunition design.

Acknowledgement: The authors acknowledge the support of this research from the Ministry of Science, Technological Development and Innovations, Contract No. 451-03-47/2023-01/200325 and University of Defense, Military Academy, Proj. No. VA-TT/1/22-24.

6-3

Composite PBX explosives with different polymer binders

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Composite explosives, which consist of crystalline nitramine high explosives and polymer binders, with or without other additives, are frequently used as primary charges or boosters in many types of ammunition. This study examines the phlegmatization of granulated polymer bonded explosives (PBX) using Viton A and Estane as polymer phlegmatizers for composite explosives containing RDX and HMX. The process of polymer precipitation from a solution in organic solvent, commonly referred to as phlegmatization, was utilized in the manufacturing of explosive compositions, in conjunction with the technology of microencapsulation. The manufactured samples were subjected to experimental analysis in order to assess their detonation parameters, including density, detonation velocity, and detonation pressure. In this investigation, the thermo-chemical computer code EXPLO5 was employed to predict the explosion characteristics of the identical samples under various operational conditions, specifically ideal and kinetic detonation modes. Through the comparison of experimental and computed data, valuable insights were obtained into the optimal modeling strategy for the composite explosives under investigation, which are composed of one of two specific polymers.

Acknowledgement: This work was supported by the Ministry of science, technological development and innovations (Serbia), Contract No. 451-03-47/2023-01/200325, and University of Defense, Military Academy, Proj. No. VA-TT/1/22-24.

6-4

Modelling the detonation pressure of phlegmatized explosives in EXPLO5

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During the chemical reaction of detonation explosives decompose and release a large amount of energy in a very short period of time. Therefore, the examination of detonation parameters brings risks, and at the same time it includes extensive work both in the laboratory and in the open-field conditions. In order to reduce these risks, various software were developed that provide detonation parameters, which is especially important with new compositions of multi-component composite explosives. In this work, the thermochemical computer code EXPLO5 was used. The software is based on the Becker-Kistiakowsky-Wilson (BKW) equation of state with the possibility of adjusting the values of the constants of the equation, as well as on the Exp-6 equation of state. Samples of pressed explosives were made on the basis of 1,3,5-trinitro-1,3.5-triazine and 1,3,5,7-tetranitro-1,3,5,7-tetrazocane, which were phlegmatized with polycarbonate and polystyrene. The content of the explosive component of the sample is 91-98 wt.%, and the phlegmatizer is 2-9 wt.%. Samples of granulated phlegmatized explosives were prepared at the laboratory conditions by the process of microencapsulation from the organic phase, and then, using a hydraulic press, cylindrical pelets were made for experimental tests. The detonation velocity was measured using a *Tektronix MSO 2022B* oscilloscope, and then the detonation pressure value was calculated. The detonation parameters were determined numerically in the EXPLO5 thermodynamic code, and for the purposes of applying this software package, different values of BKW constants were used, and Exp-6 EOS was also used. These different modeling approaches were aimed at choosing the optimal equation of state, as well as the choice of constants in the case of the BKW equation, which achieve detonation pressure values closest to experimental ones. This enables a more reliable application of numerical modeling in predicting the performance of these composite explosives.

Acknowledgement: This work was supported by the Ministry of science, technological development and innovations (Serbia), Contract No. 451-03-47/2023-01/200325

6-5

QSAR and machine learning models of redox potentials of some organic pigments

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The organic pigments offer promising opportunities for developing new sustainable electrode materials for lithium batteries. Some of them have been identified as cathode material with very encouraging reversible lithium ion storage characteristics. One of them is a naturally occurring purpurin extracted from the Madder plant (Rubia tinctorum) for which we confirmed this good electrochemical behavior by cyclic voltammetry. One of the strategies towards obtaining materials with even better characteristics is a structural modification of already existing pigments. Building a theoretical model that could predict the redox properties of these new compounds can be very useful towards achieving that goal. In order to build a 3D QSAR (quantitative structure–activity relationship) model for material redox potential prediction, 9 organic pigments with known redox potentials were extracted from the literature. Based on molecular interaction field (MIF) probes we calculated standard GRIND (grid-independent) descriptors and constructed following principal PLS (partial least squares) model. By validation with the literature data, but also with the obtained experimental data for purpurin, this model proved very reliable in predicting the redox potential. A comparison was also made with the machine learning model that was formed in parallel.

6-6

The photogenerated excess carriers influence on the photoacoustic signal of a narrow bandgap semiconductor

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In this work, the influence of photogenerated excess carriers on thermodiffusion and thermoelastic mechanisms in the total photoacoustic signal is analyzed. Optically excited n-type silicon with light periodically modulated in the audio range from 20 to 20kHz showed that photogenerated excess carriers, with bulk and surface carrier recombination, lead to creation of slow thermal source (compared to fast source caused by photo-excited phonon) that have effects on thermodiffusion and thermoelastic mechanisms of the total photoacoustic signal at frequencies up to 1kHz, but also cause additional, plasmaelastic bending of semiconductor, which has an influence on the total photoacoustic signal at frequencies greater than 10kHz.

6-7

Density functional theory calculation of the optical properties of graphene quantum dots

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Graphene quantum dots (GQDs) are class of nanoparticles exhibiting unique and tunable electronic, optical, chemical and structural properties owing to their small size and quantum confinement and edge effects. GQDs most prominent characteristics are high photoluminescence, photostability, excellent photobleaching resistance, low citotoxicity, good biocompatibility, exceptional electrochemical activity and physicochemical stability, making them suitable for a wide range of applications, from biosensing and fluorescence bioimaging usage, photodynamic therapy, to optoelectronic, susteanable agricultural and environmental applications. Using density functional theory (DFT) we demonstrate that the optical properties of the GQDs can be sensitively tuned by its size, shape, edge configuration, attached chemical functionalities.

6-8

Oxygen-terminated Ti_3C_2 MXene as an excitonic insulator

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Excitonic insulators originate from the formation of bound excitons (electron–hole pairs) in semiconductors and provide a solid-state platform for quantum many-boson physics. We determined the excitonic insulator phase of $Ti_3C_2O_2$ monolayer from its indirect quasiparticle band structure and from the precise evaluation of the relative value of the fundamental bandgap vs the momentum-indirect excitonic binding energy. The excitonic insulator is stable over the (-4% to +4%) range of compressive and tensile biaxial strain. The energy region relevant for the optical absorption is strongly strain-dependent.

7-1

Hydrogen storage properties of MgH_2-Ni system

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The effect of pure Ni addition (5 wt.%) in MgH_2 powder was investigated mechanochemically for short milling times (15, 30, and 45 min). Obtained MgH_2-Ni system was characterized by XRD, SEM-EDS, PSD, DSC, and TPD. Compared to pure MgH_2, uniform distribution of nickel reduces the temperature of H_2 desorption by more than 100 °C. It is shown that influence of two important processes, grinding and catalysis, may be followed separately. We can conclude that the catalysis of H_2 desorption by Ni particles on MgH_2 matrix is the dominant effect for the investigated short milling times.

7-2

Temperature dependence of electric properties of GO and GO/WPA films on interdigital electrodes

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In sensor devices the material of choice should be highly dependent on perturbation of environmental parameters. In order to achieve good sensitivity and selectivity of sensing devices to temperature, humidity or concentration of different gasses, the materials with adjustable properties are highly desirable. Electric properties of graphene oxide (GO) can be easily tuned by modification of surface chemistry and anchoring of functional compounds onto its two-dimensional structure. Prior to application of sensing device, research and development of materials system is the most essential step. In this work, the formation of GO and GO/12-tungstophosphoric acid (WPA) films with 6 wt.% of WPA on interdigital electrodes was investigated by variation of dip-coating parameters (receding angle and time between steps). Obtained films were thermally reduced in argon atmosphere after which optical microscopy was used to evaluate morphology and stability of deposited GO and GO/WPA films. Impedance spectroscopy was used to investigate the electric properties of the obtained films in range from 10 Hz to 100 kHz. Measured impedance values were correlated to the degree of material detachment and deposition parameters *i.e.* films showing the lowest impedance values had the smallest area of detached film. Additionally, impedance values were measured depending on the environment temperature which showed that GO/WPA films exhibit the lowest impedance values and good sensitivity to changes of temperature making it good a candidate for sensing devices.

7-3

Electrochemically exfoliated graphene as support of platinum nanoparticles for methanol oxidation reaction and hydrogen evolution reaction

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To enhance the utilization efficiency of platinum (Pt) in electrochemical energy conversion, the precise selection of support materials presents a highly promising strategy. We have developed an efficient and stable bifunctional catalyst for methanol oxidation (MOR) and hydrogen evolution (HER) reaction in an alkaline medium. The Pt-based electrocatalyst, denoted as Pt/e-rGO with low Pt loading was successfully synthesized using graphene sheets as the support via chemical reduction using formic acid as the reducing agent. Graphene sheets are obtained by anodic electrochemical exfoliation of graphite tape. Significant enhancement of intrinsic activity toward MOR and HER was achieved for Pt/e-rGO compared to the commercial Pt/C catalyst. Structural characterization was performed by TEM, SEM and XPS. XPS analysis shows that the graphene is highly reduced. TEM analysis unveiled that the majority of the Pt nanoparticles (NPs) exhibit a diameter in the range of 4-5 nanometers, which is significant because the efficiency of electrooxidation of methanol on supported Pt NPs shows a strong dependence on particle size distribution. Catalyst activity was studied by cyclic voltammetry and linear sweep voltammetry in 0.1M KOH. Electrochemical active surface area (ECSA) was measured by CO-stripping voltammetry and estimated to be 67.93 m^2/g. Current density of 11.28 mA/cm^2_{ECSA} at 0.82 V vs. RHE for MOR is achieved. Onset potential for MOR is 0.55 V vs. RHE. Meanwhile, for HER overporential at the current density -10 mA/cm^2_{ECSA} was 119 mV.

7-4

$ZnO@RuO_2$ composites: Cost-effective trifunctional electrocatalysts for enhanced OER, HER, and ORR activities in water electrolysis

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Affordable catalysts for use in water electrolysis and fuel cells as clean energy sources pose a significant challenge. Currently, platinum group metal catalysts are both expensive and difficult to obtain. In this research, an attempt is made to address this issue by investigating methods to reduce costs. Specifically, the use of RuO_2 instead of Ru and the incorporation of a substantial amount of easily available ZnO, which has various applications, are explored.
A composite of $ZnO@RuO_2$ in a 10:1 molar ratio was synthesized using microwave processing of a precipitate. To enhance its catalytic properties, the composite was subsequently annealed at 300 and 600 °C. A detailed analysis of the crystal structure, morphology, optical and (photo)electrocatalytic properties of the processed $10ZnO@RuO_2$ catalyst particles was conducted. The catalytic activity of the prepared composites toward the hydrogen evolution reaction (HER) and oxygen evolution reaction (OER) in 0.1 M NaOH and 0.1 M H_2SO_4 was investigated using linear sweep voltammetry (LSV). The measurements were taken both in the dark and under illumination after 60 minutes of exposure. To determine the intrinsic HER and OER activity of the studied catalyst, the LSV data were normalized by the electrochemical surface area (ECSA). Finally, the oxygen reduction reaction (ORR) activity of the catalysts was tested in both alkaline and acidic electrolytes.

7-5

Investigating the influence of hydrothermal treatment on oxygen functional groups in graphene oxide-based nanocomposites

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Different hierarchical ordering of nanomaterials, either as individual components or in the form of nanocomposites, is one of the approaches used for the development of supercapacitors. In this work, the effect of hydrothermal treatment on oxygen functional groups of nanocomposites between graphene oxide (GO), 12-tungstophosphoric acid (WPA), and 3,4,9,10-perylenetetracarboxylic dianhydride (PTCDA) was examined. The mentioned materials were hydrothermally treated for 4, 8 and 12 hours at 180 °C in order to understand how interaction between the components is influencing development of surface chemistry. The results of Fourier-transform infrared spectroscopy (FTIR), Raman spectroscopy (Raman), and temperature-programmed desorption (TPD) are showing the surface and structural changes of GO (individually and in nanocomposite) as a result of hydrothermal treatment. Both FTIR and RAMAN confirm the presence of WPA and PTCDA. Additionally, it appears that hydrothermal treatment has no impact on the structural changes in PTCDA, which is consistent across various temperature conditions. TPD results indicate that prolonged hydrothermal treatment leads to a gradual increase of the number of functional groups of GO. However, the number of desorbed groups is influenced by the WPA and PTDCA components. This research offers new insights into GO, WPA, and PTCDA interactions which can have useful implications for development of electrochemical supercapacitors.

7-6

Enhanced electrochemical detection of gallic acid using modified glassy carbon electrodes with Zn/Ga-dopped cobalt ferrite

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In this study, solvothermally synthesized nanoparticles of cobalt ferrite ($CoFe_2O_4$, CFO) and Zn/Ga-dopped cobalt ferrite ($Co_{0.5}Zn_{0.5}Fe_2O_4$, CFO_Zn and $CoFe_{1.5}Ga_{0.5}O_4$, CFO_Ga, respectively) with dihydrocaffeic acid (DHCA) as a surfactant were examined for electrochemical detection of gallic acid. Based on X-ray diffraction analysis, diffraction maxima of all samples correspond to the cubic spinel phase, while transmission electron microscopy showed that the nanoparticles are non-agglomerated, sphere-like with an average size of 5±1 nm. The presence of DHCA on the surface of nanoparticles was confirmed by Fourier Transform Infrared Spectroscopy (FTIR). For the purpose of electrochemical detection of gallic acid the modified glassy carbon electrode (m-GCE) was prepared from CFO, CFO_Zn and CFO_Ga nanoparticles. Initial tests have shown instability/disintegration of m-GCE in aqueous solutions, because of which samples were annealed at 450 °C in air. Cyclic voltammograms of all annealed samples showed good reversibility in the system $[Fe(CN)_6]^{3-/4-}$. The most efficient electron transfer was achieved when the mass ratio between sample and Nafion® was 85:15, respectively. The best sensitivity to gallic acid (10^{-4} M, in Britton-Robinson buffer) was observed for CFO_Zn sample. Results are showing that by selective functionalization and surface modification of nanoparticles, it is possible to optimize the electrochemical properties suitable for sensing, which is the basis of this method and the goal of further research.

8-1

Yb^{3+}/Tm^{3+} doped $SrGd_2O_4$ as photoluminescent and photocatalytic material

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In this work we present new up-conversion materials, consisted of $SrGd_2O_4$ doped with different concentration of Yb^{3+} (2, 4, 6 at%) ions and constant concentration of Tm^{3+} (1 at%), prepared by the combustion method. X-ray powder diffraction (XRPD) showed that as-synthesized nanoparticles have orthorhombic structure (Pnma), assigned to the JCPDS Card No:01-072-6387. Scanning electron microscopy (SEM) revealed that obtained nanostructure is composed of porous agglomerated nanoparticles, while energy dispersive spectroscopy (EDS) confirmed presence and uniform distribution of all constituting elements accross the sample. Luminescent properties were evaluated and discovered two blue emission bands at 450 nm and 474 nm, and one red emission band at 650 nm. The sample co-doped with 4 at% Tm^{3+} showed the most intense photoluminescent emission, and because of that was used in the photocatalytic exiperiment. UV-VIS Diffuse Reflectance Spectroscopy was performed in order to examine materials bandgap, and value of 4.3 eV was obtained as well as the additional values from the bands at lower energies, which indicate potentially good photocatalytic properties. X-ray photoelectron spectroscopy (XPS) revealed presence of OH^- groups on the surface which also have positive impact on the photocatalytic performances of the material. UV-VIS Absorption Spectroscopy was used to measure changes of the methylene blue concentration during the photocatalytic degradation process. After 4 h of exposure to the simulating Sun irradiation, the results indicate successful dye decomposition rate. Reaction parameters (MB concentration and catalyst mass) were altered in order to achieve the best photocatalytic performances of this newly synthesized materials.

8-2

Physicochemical characterization of mechanochemically activated pyrophyllite/Ag composites

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Nanocomposites synthesized by incorporating nanostructured materials within the interlayer spaces of clay minerals have gained tremendous interest lately, owing to their exceptional physicochemical properties and vast potential in various fields. This study focuses on the mechanochemical activation of pyrophyllite, a commonly used natural clay material, using $AgNO_3$ at different concentrations (2, 5, and 10 wt%). The activation process involved grinding the materials for varying durations ranging from 20 to 320 minutes. The resulting samples were analyzed using FTIR, TGA, and DTA thermal analysis techniques, XRD, SEM with EDX as well as PSD method for particle size distribution analysis. The results have shown a homogeneous distribution of silver along the analyzed surface. The duration of grinding and the amount of added silver greatly influence the composite physicochemical properties.

Acknowledgement: This work was supported by the Ministry of Education, Science and Technological Development of the Republic of Serbia Grant No. 451-03-68-2022-14/200017

8-3

Measurement of EMI shielding perfomance of graphene oxide – silver nanoparticles composites

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Silver nitrate has been exposed to low-dose (1–20 kGy) gamma irradiation in the presence of graphene-based material (graphene oxide or electrochemically exfoliated graphene) to form silver nanoparticles (Ag NPs). The successful nucleation and growth of Ag NPs, which produce the evenly covered graphene surface, are made possible by the vast surface area of those graphene-based materials as well as the presence of oxygen-containing functional groups on the surface. With a significant size distribution of 10–50 nm for graphene oxide and 10–100 nm for electrochemically exfoliated graphene, the produced Ag NPs were spherical. We also performed ElectroMagnetic Interference (EMI) shielding performance measurements of these materials. EMI shielding performance measurement revealed relatively good performance of the EEG material whereas GO material does not show EM shielding.

Acknowledgements: This project has received funding from the European Union's Horizon Europe Coordination and Support Actions programme under grant agreement No 101079151 - GrInShield. The research was also supported by the Science Fund of the Republic of Serbia, #7741955, Are photoactive nanoparticles salvation for global inflectional treath? - PHOTOGUN4MICROBES and by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia, grant number 451-03-47/2023-01/200017.

8-4

Plasmon induced enhancement of photoinduced antibacterial activity of graphene quantum dots

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Due to the exponential growth of bacterial infection as well as resistance toward most antibiotics, the development of new materials for treatment is urgently needed. In recent years, graphene quantum dots (GQDs) have been identified as promising carbon nanomaterial for eco-friendly antibacterial applications due to their optical and chemical stability, non-toxicity, and biocompatibility. One of the reported GQD's antimicrobial mechanisms is the photo-induced production of singlet oxygen ($^1O_2$). Under light exposure, GQDs transfer the energy to molecular oxygen from the surrounding medium. Oxygen molecules transform to their excited form $^1O_2$, which causes oxidative stress in bacterial cells and reduces their viability. In this study, pristine GQDs were produced in an easy, one-step electrochemical top-down approach using graphite electrodes as a starting material. Carboxyl groups of GQDs are modified using a carbodiimide coupling reaction catalyzed by 1-ethyl-3-(3-dimethylaminopropyl)carbodiimide (EDC), with ethylenediamine (EDA) as an amine. In the next step, these NH_2 terminated dots were decorated with gold nanoparticles (AuNPs) by the same EDC coupling procedure. Abillity of GQDs-AuNP nanocomposite to generate singlet oxygen upon blue light (470 nm) was investigated by UV-Vis spectroscopy and 9,10-anthracenediylbis-(methylene)dimalonic acid (ABDA) as selective $^1O_2$ traping agent. After 2 hours of blue light illumination, the band at 420 nm charachterisic for ABDA was completly disaperided only in the presence of the GQD-AuNPs indicating good prooxidative potential of composite. Photoinduced antibacterial effects of GQD-AuNPs were studied using minimum inhibitory concentration (MIC) test which showed great antibacterial activity against several bacterial strains.

Acknowledgements: The research was supported by the Science Fund of the Republic of Serbia, #7741955, "Are photoactive nanoparticles salvation for global infection threat?-PHOTOGUN4MICROBES and by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia [grant number 451-03-68/2023-14/200017].

8-5

Innovative modifications of graphene quantum dots for improved photodynamic therapy in antibacterial treatment

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Considering the rising concern of antibiotic resistance, developing advanced antibacterial solutions is highly needed. The ability of graphene quantum dots (GQDs) to generate reactive oxygen species (ROS) upon light exposure made them promising candidates as agents in photodynamic therapy for combatting infections, including antibiotic-resistant strains. GQDs show versatile chemical, physical, and biological properties such as high fluorescent activity, resistance to photo-bleaching, low toxicity, excellent solubility, and biocompatibility. This research focused on exploring the ability of GQDs to produce singlet oxygen under blue light exposure. We used two singlet oxygen probes, 9,10-anthracenediyl-bis(methylene) dimalonic acid and 1,3-diphenylisobenzofuran to study photoinduced production radicals from several GQDs. To tune the ability of GQDs to generate ROS, we used gamma irradiation in two different media, the presence of L-cysteine and cyclopentanone. The results showed improvements in singlet oxygen production in both cases. However, the modification conducted with cyclopentanol showed notably higher efficacy in promoting singlet oxygen production. This research demonstrates the increasing significance of GQDs in discovering new methods to combat bacteria. The modification of GQDs with gamma irradiation leads to increased production of singlet oxygen enhancing the effectiveness of photodynamic therapy for treating infections.

Acknowledgment: This research was supported by the Science Fund of the Republic of Serbia, #7741955, "Are photoactive nanoparticles salvation for global infection threat?"—PHOTOGUN4MICROBES, and by the Ministry of Science, Technological Development and Innovation of Republic of Serbia (grant number 451-03-68/2023-14/200017)

8-6

Enhanced photocatalytic performance of $BaTiO_3/MoO_3$/Ag ternary heterostructure

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In this work, we have fabricated an efficient ternary heterostructure photocatalyst by integrating ferroelectric $BaTiO_3$ (BTO) as the bottom layer, semiconductor MoO_3 as the middle layer and plasmonic silver nanoparticles (Ag NPs) as the top layer, respectively. The $BaTiO_3/MoO_3$/Ag (BMA) heterostructure exhibits a higher photodegradation efficiency and photocatalytic activity of 100 % for rhodamine B (RhB) dye under a UV-visible light illumination of 60 min when compared with its binary heterostructure counterparts $BaTiO_3$/Ag (BA) and MoO_3/Ag (MA). The increased photocatalytic activity in BMA heterostructure is attributed to its enhanced interfacial electric field due to the electric double layer formation at BTO-MoO_3 and MoO_3-Ag interfaces. The higher blueshift in the surface plasmon resonance (SPR) peak observed for the BMA heterostructure clearly indicates an increased electron transfer towards the top Ag NPs layer under optical illumination. The higher resistive switching ratio, the increased difference in voltage minima and the improved photocurrent generation, as evident from the I-V characteristics, illustrates the enhanced charge carrier generation and separation in BMA heterostructure. A smaller arc radius observed for the Nyquist plot of BMA heterostructure clearly showcases its increased interfacial charge transfer. The charge transfer mechanism and reusability of the BMA heterostructure are also studied.

9-1

Thin film deposition of multilayers on silicon substrate laser pre-patterned

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In scientific and commericial needs, there was a great demand for the modification of biomaterials that would replace damaged tissue in the body. Today, titanium alloys are mostly used for these purposes in combination with metals of similar physicochemical properties. In this context, there is an increased interest in the development of novel biocompatible materials with enhanced surface interface. The experimental results of a Ti/Zr/Ti thin film system deposited on a substrate pre-patterned by a dynamic femtosecond laser are presented. Surface pattering with micrometre characteristics in the form of spikes is being investigated in order to generate arrayed surface patterns for biomedical pruposes. Femtosecond laser pulses were used to acquire black silicon surfaces adorned with conical structures under 0,65 bar in SF_6 ambient pressure. The silicon surface contains high aspect ratio spikes with conical morphologies of about 2μm, 40^0 angle opening, and $13 \cdot 10^6$ cm^{-2} density that is roughly uniform over the treatment area. Ion sputtering was employed on sech a prepared surface to make a unique composite thin film composed of two layers of Ti and a subsurface layer of Zr. The deposited Ti/Zr/Ti cpomiste has a thickness of 400 nm. The composition and surface morphology were evaluated using FESEM-EDS and XPS methods. Transmission electron spectroscopy and energy dispersive X-ray spectroscopy demonstrated that post-deposition of Ti/Zr/Ti over Si laser-patterned resulted in diffusion of Ti and Zr layers.

9-2

UV protection with novel porous organosilica nanoparticles

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Different types of molecules and nanoparticles are being used currently as active components for ultraviolet (UV) protection in sunscreens. Herein, we report on stable and potent novel active UV blockers, organosilica nanoparticles, which are synthesized, characterized, and demonstrated for capabilities to block UV irradiation. These are hybrid organic-inorganic particles, with the role of organic component in providing potent absorption of UV irradiation, while inorganic silica framework ensures the stability of the nanoparticles. This material is synthesized in basic aqueous environment, at room temperature, using cetyltrimethylammonium bromide as a porosity template and organosilica precursors such as 4,4'-bis(triethoxysilyl)biphenyl and a UV-blocking organosilica precursor prepared in situ from 4,4′,4″-s-Triazine-2,4,6-triyl-tribenzoic acid (TTTBA). The Fourier-transform infrared spectroscopy (FTIR) characterization of synthesized precursor clearly shows bands arising from the amide group vibrations at 1614 cm^{-1} and from Si-O groups at 1096 cm^{-1} that confirms successful silanization of the starting TTTBA molecule. The organosilica structure of the synthesized nanoparticles have also been examined by Scanning electron microscope (SEM), Thermogravimetric Analysis (TGA), nitrogen sorption and and FTIR spectroscopy, and the results confirmed the assumed composition of organosilica materials. The UV characteristics of the material were examined through UV/VIS spectroscopy revealing its capacity to absorb UV radiation. Two-photon excitation microscopy (TPEF) revealed capabilities of the material to exhibit two-photon fluorescence properties upon excitation with a femtosecond laser in NIR region. Furthermore, the material exhibited photostability upon exposure to sun-simulated lamp and femtosecond laser. Stability of the suspension of the particles was demonstrated by Dynamic light scattering (DLS) analysis in water for the duration of 48 hours.

Acknowledgment: This research has received funding from the Innovation Fund of the Republic of Serbia, programs Proof of concept (#5566) and Technology transfer (#1135).

9-3

Photoelectrochemical water oxidation properties of bismuth vanadate photoanode irradiated by swift heavy ions

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Photoelectrochemical (PEC) water splitting is a promising route for solar energy harvesting and storage. The most challenging obstacle for efficient water splitting is development of catalysts for oxygen evolution reaction (OER). Monoclinic bismuth vanadate ($BiVO_4$, BVO) stands out as an excellent photoanode material due to its high stability in near-neutral electrolytes, suitable band structure and low-cost synthesis. However, pronounced charge recombination is a huge limiting factor and understanding the effects contributing to it is important for further improvements. In present study, we report the effect of swift heavy ion (SHI) irradiation (Xe, 150 MeV, $1 \times 10^{10} – 5 \times 10^{11}$ ions cm^{-2}) on physicochemical properties of hydrothermally synthesized BVO thin films. X-ray diffraction (XRD) study showed that irradiated material preserved initial monoclinic scheelite phase and preferential growth along [010] direction together with the presence of notable amorphization at the highest fluence. Scanning electron microscopy (SEM) of all samples showed prismatic grains with an average size of 600 nm with the appearance of ion tracks after irradiation. More detailed examination of 1×10^{10} ions cm^{-2} irradiated sample by transmission electron microscopy (TEM) revealed presence of amorphous ion tracks (~ 10 nm in diameter) and hillocks at the BVO surface (~ 10 nm in height). Raman spectra showed bands that correspond to the monoclinic scheelite phase as well as the presence of new bands for 5×10^{11} ion cm^{-2} irradiated sample at 420 and 915 cm^{-1} that originate from complex vanadium oxides. X-ray photoelectron spectroscopy (XPS) after SHI irradiation showed an increase of V^{4+} states and oxygen vacancies, especially at higher fluences. Diffuse reflectance spectroscopy (DRS) measurements showed decrease of band gap with the increase of fluence. Photocurrent densities, obtained from 1-hour-long chronoamperometry measurements, showed that irradiation with 1×10^{10} ions cm^{-2} fluence leads to gradual recovery of PEC oxygen evolution with time. XRD, SEM and XPS measurements performed after PEC reveal complex changes in the BVO, including dissolution of the material along ion tracks.

9-4

Improvement of Au-poly(N-isopropylacrylamide) hydrogel nanocomposites: Single-layer vs. bi-layered systems

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In recent years, the need for innovative materials has produced remarkable progress in the field of smart materials, with a particular focus on nanocomposite systems containing cross-linked polymer matrices (hydrogels) and metal nanoparticles. Hydrogels have become a crucial class of biomaterials due to their stable 3D porous structures, high fluid absorption capacity, similarity to biological tissues, and biocompatibility. Of particular interest are hydrogels with the ability to respond to various external stimuli (temperature, pH, light etc.), resulting in alterations of their physical and chemical characteristics. Our research focuses on the nanocomposites based on thermosensitive poly(N-isopropylacrylamide) (PNiPAAm) hydrogels and gold nanoparticles (AuNPs), with a unique emphasis on exploring the specific properties of single-layer and bi-layered systems. The insights gained from this comparative study open new possibilities for applications in drug delivery, sensors, and soft robotics. Single-layer systems consisting of active PNiPAAm hydrogel and AuNPs, were created through a combination of radiolytic and chemical procedures. Bi-layered systems feature an active Au-PNiPAAm layer, with the addition of a passive poly(vinyl alcohol) (PVA) hydrogel layer, crosslinked by the combination of freeze-thaw and radiolytic techniques. In both cases, the incorporation of spherical AuNPs within an active layer was confirmed by the presence of a characteristic surface plasmon resonance (SPR), while scanning electron microscopy (SEM) indicated the system's highly porous structure. The physicochemical properties of both single- and bi-layered systems involved the examination of their swelling and deswelling properties, as well as the volume phase transition temperature (VPTT). The incorporation of AuNPs in the PNiPAAm layer led to an increase in both swelling capacity and VPTT. Compression measurements showed that the presence of a passive layer and AuNPs significantly improved mechanical properties of nanocomposites.

Acknowledgments: This work was supported by the International Atomic Energy Agency (CRP F22070, Contract No. 23184) and the Ministry of Science, Technological Development and Innovations of the Republic of Serbia (Contract No. 451-03-47/2023-01/200017).

9-5

Radiological and structural analysis of aluminosilicate materials incorporated with samarium (III)-oxide

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This study focused on analyzing samples of aluminosilicate materials in which different percentages of samarium (III)-oxide were incorporated. Basic samples and thermally treated samples at 600 °C were analyzed. Introducing samarium (III)-oxide into the polymer matrix of aluminosilicates has been demonstrated to alter the fundamental structure of aluminosilicate materials. Interestingly, at elevated temperatures, these materials exhibit even more distinctive properties. The gamma ray spectrometric analysis results were used to conduct radiological analysis. Different methods monitor physico-chemical changes within the aluminosilicate materials. By introducing Sm^{3+} into the aluminosilicate matrix, the basic structure of the aluminosilicate is disturbed. The DRIFT method was used to analyze the structural properties. The analysis of the microstructural properties of the selected samples was carried out using a scanning electron microscope (SEM) and enabled the examination of the fine details of the structure of the materials thermally treated at 600 °C which resulted in the appearance of significant pores and cracks in the material.

9-6

Comparison of the conventional and green microemulsion synthesis of the manganese oxide nanoparticles

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Manganese oxide nanoparticles are highly applicable in a number of applications. For example, making batteries, decolorizing glass, for medical purposes, as catalysts, etc. Synthesis methods might be different, are classified into two groups: bottom-up (sol-gel method, pyrolysis, chemical vapor deposition and biosynthesis) and top-down (mechanical grinding, laser ablation and thermal decomposition. Present paper was realized in Bosnia and Herzegovina which has a small manganese ore mine extracting around 40 000 tonnes yearly. Thus, in collaboration with Franch partners, study was conducted in order to exploit the possibilities for producing the added-value products in proximity of the mine. The product of choice could be manganese oxide nanoparticles. Paper is presenting considerations on weather the conventional microemulsion synthesis or the "green" ones are more suitable and economically acceptable. One batch of the manages oxide were produced from potassium permanganate using synthetic surfactant for microemulsions, while the other series were produced suing the "green" emulsion agents. However, in the former method, exclusively extracts of the plants considered as waste (the weeds) which is a new, still seldomly used approach. Characterization of the obtained nanoparticles by HRTEM and XRD will be shown and results appropriately discussed.

9-7

Preparation of dispersion strengthened nanocomposite with Al_2O_3 and MgO particles by spark plasma sintering

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Nanocomposites are multiphase materials in which at least one of the structural compounds has a size below 100 nm. The subject of this work is creation of a dispersion-strengthened nanocomposite (DSC) with copper matrix. There are many dispersions that are possible to be used in DSC with copper matrix, such as Al_2O_3, Y_3O_2, TiO_2, and WC. In this work we used Al_2O_3 due to the possibility of making even dispersion in the material and its economical availability. Such composites exhibit thermal stability of their mechanical properties up to 900 °C for at least 1 hour exposure, which opens new possibilities for use of such materials in high-temperature, high-strength applications. Materials created by our team exhibited good mechanical properties, namely hardness, which was up to 136 HB; however, it has to be noted that amount of dispersion particles had a direct effect on the hardness of the composite. Properties of the DSC´s are also dependent on the method of its preparation and compactization. Composites in this work were prepared by powder metallurgy method and sintered by spark plasma sintering, which allowed these composites to reach 99% density. Furthermore, DSCs were tested for their thermal stability, and their properties were evaluated and compared even with precipitation-strengthened copper-chrome material in order to show potential of possible usage of DSCs in spot welding applications, which require high strength, hardness, and electric conductivity.
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10-1

Properties of polymer/MXene nanocomposite films

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Electronic devices growing in striking numbers each day emit and transmit electromagnetic interferences (EMI). The next generation of EMI shielding materials need to be ultrathin, mechanically strong, flexible, lightweight, and highly efficient in blocking the electromagnetic waves. An ideal candidate is polymer nanocomposite with conductive nanofillers, such as MXenes. MXenes are novel two-dimensional nanomaterials, namely transition metal carbides/nitrides and have been widely applied in the fields of electronic applications, because of their outstanding mechanical, electronic, magnetic, and optical properties. In this study, MXene/polyurethane (PU) composites were prepared and characterized. PU nanocomposites based on the functionalized MXene, with different soft segment content, were prepared. Their morphological and structural characterization was conducted via scanning electron microscopy (SEM) images, X-ray diffraction (XRD) patterns, whereas the mechanical properties were studied by tensile tests. Thermal stability was estimated by thermogravimetric analysis (TGA). The obtained results showed that a good dispersion of functionalized MXenes in PU matrix is achieved. The prepared nanocomposite films had very good mechanical properties. The increase of the soft segment content in PU matrix induced appearance of the microphase separated morphology, increase of thermal stability, and improve of mechanical properties. The obtained results indicate that by choosing adequate soft segment content, PU nanocomposite films based on the functionalized MXene with diverse features can be designed for convenient and desired application.

Acknowledgment*:* This research has been financially supported by the Ministry of Science, Technological Development, and Innovation of Republic of Serbia (Contract No: 451-03-47/2023-01/200026).

10-2

"Green" synthesis of silver nanoparticles and their biosafety

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In recent decades, the development of «green» nanotechnology has provided a wide variety of metal nanoparticles with different structures and purposes. In particular, silver nanoparticles (AgNPs) have significant antimicrobial activity, but there is an important to predict their biosafety. The aim of the work was to study the biosafety of AgNPs obtained by the method of "green" synthesis from plant raw materials using water-alcohol and water plant extracts (Table). The particle size distribution (D_{ef}) in the aqueous dispersions was studied by the Quasi-Elastic Light Scattering method. Their stability was determined according to the Turbiscan Stability Index (TSI). All dispersions showed a bimodal PSD (Table). AgNP#3 aqueous dispersion demonstrated the best stability: the TSI value ≤ 5.7, and this sample has also the lowest D_{ef}. The safety of AgNPs was determined in genotoxicity test *in vitro*. AgNP genotoxicity as system biomarker, has been determinated on the test-culture L929 (an adherent type of mouse fibroblast cell line) by the "Comet-assay" method. The studies proven that synthesized AgNPs are not genotoxic for eukaryotic cells, and therefore, the entry of such AgNPs into the body of humans or animals will not lead to damage to their genetic apparatus.

Table. Average hydrodynamic particle diameter D_{ef} and stability of AgNPs

Sample	Extract used for reducing	D_{ef}, nm	TSI (1 day)	TSI (30 days)
AgNP#1	water-alcohol, eucalyptus	5 nm, 35 nm	6.1	22.4
AgNP#2	aqueous, eucalyptus leaves	5 nm, 40 nm	3.7	15.4
AgNP#3	aqueous solution of tannin	4 nm, 35 nm	2.8	5.7
AgNP#4	aqueous, aloe leaves	9 nm, 60 nm	*4.9*	*10.3*

Acknowledgment: The authors S. Dybkova and O. Goncharuk are grateful for the financial support by PAS and NAS of USA within Long-term program of the support for Ukrainian scientists (project «Biocompatible hybrid hydrogels with functional inorganic fillers for strengthening of plant vegetation»).

10-3

PLD growth of strontium titanate thin films on SrO-deoxidized and rGO-buffered Si(001) substrate

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Epitaxy represents a process of crystal growth or material deposition in which the new created layers have a high degree of crystallographic alignment with the substrate lattice. In this research 10 nm-thick thin films of strontium titanate (STO) were grown using pulsed laser deposition (PLD) method on Si(001) whose surface was either deoxidized with strontium oxide (SrO) or buffered by reduced graphene oxide (rGO) in combination with SrO deoxidation. In addition to differently prepared Si(001) surface, the effect of deposition temperature on the crystalline structure of the STO thin films was also examined. Reflection high energy electron diffraction (RHEED), atomic force microscopy (AFM), X-ray diffraction (XRD), X-ray reflectivity (XRR) and X-ray photoelectron spectroscopy (XPS) methods were used to examine the properties of the grown films. It was concluded that the STO thin film grown on the rGO-coated Si substrate at 515 °C shows the highest crystallinity with a smooth surface, while the film deposited on the bare silicon has amorphous structure. The STO films grown at 700 °C show textured or polycrystalline structure. Good crystallinity, epitaxial alignment, and clean interface are the major requirements for STO/Si and the STO/rGO/Si heterostructure for making an efficient and stable Si photocathode for the photoelectrochemical (PEC) water splitting. Our future work will be directed toward understanding how the obtained interfaces and crystalline structure of STO films are influencing the PEC process.

10-4

Study of abnormal grain growth in cold-rolled AA5182 Al-Mg alloy

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Studies of recrystallization and grain growth phenomena have a long history, but the causes of abnormal grain growth (AGG) are not well understood. We report on the results of the study of the occurrence of AGG in Al-Mg alloy AA5182. The industrially produced hot band underwent various routes of thermo-mechanical processing: inter-annealing, cold rolling with reductions ranging from 40-85% followed by isochronal anneal (1h) in the temperature range 350-520°C or isothermal treatment at 480°C for various times. The microstructural characterization was conducted by optical microscopy in polarized light and FEG SEM, while the EBSD technique was used for microtexture analysis of the selected states. The results showed that the temperature for the onset of the AGG decreases as the degree of cold reduction increases. The abnormal grains start to appear in the regions close to the surface, i.e., within 1.5 mm from it in the inter-annealed 12 mm thick hot band or 700 μm in the case of cold rolled sheet with 64% reduction. Initially equiaxed, abnormal grains show strong growth anisotropy with much faster growth in the rolling than in the normal direction. Growth anisotropy was attributed to the rod-like shape and alignment of Al_6Mn dispersoids through Zener pinning. With extended annealing, bands of abnormal grains form parallel to the surfaces. Microtexture analysis of the sample with incipient abnormal grains showed the presence of retained rolling texture components in the form of R-fibre. In contrast, the incipient abnormal grains appear to have orientations of cube variants, the texture components which are at or below random level. Since the texture is similar throughout the sheet, it is likely that the AGG starts first in the surface region due to the non-uniform deformation and distribution of the intermetallic particles.

Acknowledgment: This work was supported in part by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia (Contract No. 451-03-47/2023-01/200135). F. R. and D.P. were financed by the Science Fund of the Republic of Serbia through project RECON TETHYS (7744807). We also gratefully acknowledge the help of the Science Fund of the Republic of Serbia in granting the EBSD instrument and software.

10-5

Analysis of the change in structural parameters of mechanically alloyed Cu composite materials using different milling methods

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In this study, the Cu-Zr-B ternary system was investigated as it has proven to be a promising composite material used in various industries, including aerospace, automotive, electronics, nuclear and tooling, among others. Owing to its versatility and a combination of desirable properties such as high strength and hardness, corrosion and wear resistance, and thermal stability, making it suitable for a wide range of applications. The effects of mechanical alloying (MA) parameters on the Cu-Zr-B properties, including ball-to-powder ratio, rotation speed, milling time, and milling atmosphere, were examined using the X-ray analysis, scanning electron microscopy, stereological analysis, and the Williamson-Hall analysis. Different mills, namely Atritor Mill and Turbula Shaker, were used in order to determine the effect that the type of mill has on the final structural parameters of the Cu-Zr-B. All results are given after 20 hours of mechanical alloying of the composite material. The rotation speed was around 300 rpm for both devices, and the ball-to-powder ratio was 10:1 for all the cases. It was shown that the ball size also plays a significant role in the final microstructural and morphological properties of the MA powders of the Cu-Zr-B. A comprehensive analysis showed that the powders produced in the Atritor mill (Powder 1, with a uniform ball size), as well as the powders produced in the Turbula where there was a range of different ball sizes used (Powder 2), showed lower values of dislocation density and crystalline size values compared to the powders produced in the Turbula with a uniform ball size (Powder 3). It is important to state that, with time, due to the plastic deformation mechanisms present, crystallite size decreases in all cases, with the lowest value again being powder 3.

10-6

Synthesis and high-temperature / high-pressure exposure of compositionally complex rock-salt-type transitional metal (carbo) nitrides

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Transitional metal carbides and nitrides, especially of group IV and V metals, are well known in the ceramic field due to their good thermal, electrical properties, high hardness, and high temperature stability making them useful in applications that require high hardness and resistance to various corrosive atmospheres. There is abundant thermodynamic data available on binary transitional metal carbides and nitrides, such as P-T phase diagram, thermal expansion, Debye temperature and physical parameters, e.g., elastic moduli; while this is rather not the case for ternary and other high complex compositions. Transitional metal nitrides, especially those of group IV metals, are known to form simple, high symmetry structures at ambient conditions, i.e., rock salt. However, at high pressure and temperatures, the metal nitrides were observed to undergo phase transition and these thermodynamically stable high-pressure phases were observed or predicted to be denser, harder with distinct properties compared to that of the ambient condition phase. In the present work, two carbonitride-based complex compositions i.e $(Ti_{0.2}Zr_{0.2}Hf_{0.2}Nb_{0.2}Ta_{0.2})N_xC_{1-x}$ and $(V_{0.2}Nb_{0.2}Ta_{0.2}Mo_{0.2}W_{0.2})N_xC_{1-x}$ were synthesized via a non-oxidic sol-gel process using the respective metal amido complexes and ammonia followed by a thermal ammonolysis at 1000 °C. The obtained phase-pure carbonitrides were structurally characterized by X-ray diffraction and electron microscopy and then considered for performing experiments under extreme conditions i.e pressures up to 20 GPa and temperatures as high as 1900 °C. The experiments were performed in the large volume press facility at the beam line P61B DESY. The in-situ x-ray diffraction study during the high-temperature high-pressure treatment revealed that the rock salt structure of the compositionally complex carbonitrides was stable under the conditions of exposure and allowed to quantify for the first time some basic physical parameters thereof, e.g., thermal expansion and bulk modulus, which were calculated by using 3rd order Birch Murnaghan equation of state.

11-1

Metabolic insights through nondestructive monitoring: A case study on *Vriesea carinata*

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In the current global context of agriculture and plant physiology research, recent advancements have introduced innovative nondestructive optical techniques that continuously measure optical reflection and transmission coefficients. These advancements enable real-time monitoring of plant metabolic activities, in contrast to traditional destructive methods, which involve collecting plant tissue samples like leaves, roots, or stems and subjecting them to physical disruption during analysis, causing damage to the plant material, nondestructive techniques allow for real-time monitoring without harming the plant.This study focuses on *Vriesea carinata*, a plant species known to exhibit both C3 and CAM photosynthesis under specific conditions, to illustrate the potential of nondestructive methods for metabolic detection. Multiple samples of *Vriesea Carinata* plants underwent a drought regimen, with one group receiving no watering and another being watered every two days to induce drought stress. This approach aimed to potentially trigger a transition from C3 to CAM photosynthesis. All other conditions, including temperature, humidity, and light intensity, remained consistent for both groups. As a result, we observed two distinct, completely inverted circadian rhythms in both sets of plants, leading us to conclude that metabolic changes can be successfully detected using this nondestructive approach. To fully validate this method, we will compare it with traditional measures, such as assessing the products of photosynthesis, malic acid levels, cellular respiration rates, CO_2 exchange measurements, and microscopic observations of stomatal behavior under varying metabolic conditions. In conclusion, this innovative approach not only enhances our understanding but also broadens the horizons of its practical applications. It holds the potential to advance both plant research and agricultural practices.

11-2

Continuous monitoring of leaf optical properties for the early pathogen detection in sweet chestnut

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In this study, we used a non-destructive optical method to detect changes in the circadian rhythm of sweet chestnut leaves infected with *Phytophthora plurivora* and exposed to the herbivory by the spongy moth (*Lymantria dispar L.*). Early pathogen detection in plants is crucial due to their widespread presence in remote environments. Our innovative method continuously monitors leaf optical properties, enabling early stress identification and swift intervention. To validate this method, one group of plants was intentionally infected with the pathogen (flooding treatment), while another group was kept healthy for an extended period, both subjected to identical environmental conditions. Infected sweet chestnut seedlings showed significant changes in just three days. The infected group's circadian rhythm had an initial peak, a reduced amplitude, and then a pronounced peak. Notably, no visible changes were observed even after four weeks, underlining the method's early pathogen detection capability. In our examination of the interaction with *Lymantria dispar larvae*, we conducted experiments involving both infected plants and the control group. Surprisingly, the method did not detect any noticeable alterations in the circadian rhythm. This unexpected outcome raises the possibility that the caterpillars were not positioned on the specific leaves that were under observation. In summary, our non-destructive optical method has shown promise in early pathogen detection by monitoring circadian rhythm changes in sweet chestnut leaves infected with *Phytophthora plurivora*. However, challenges arising from caterpillar interactions underscore the need for further, in-depth investigations to address this method's limitations and harness its full potential for timely disease management in plants.

11-3

Real-time Detection of Early Signs of Mg and N Deficiency in Hydroponically Grown *Ocimum basilicum*: An Innovative Optical Approach with Nutrient Recovery Insights

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Detecting nutrient deficiencies in plants is pivotal for ensuring robust crop growth and sustainable agriculture. It not only enhances food production efficiency but also reduces resource wastage and mitigates environmental damage caused by excessive fertilizer usage. Different techniques are available for identifying nutritional stress in plants, such as plant tissue analysis, wherein dried plant samples undergo chemical analysis in a laboratory, providing an instantaneous snapshot of the plant's nutrient status at the time of sampling. In contrast, our method offers real-time results without any harm to the plants. In this case study involving *Ocimum basilicum*, our experimental setup consisted of two independent groups. The first group, serving as the control, was hydroponically cultivated under standard conditions with a complete nutrient profile, while the second group was grown under identical conditions but lacking two essential nutrients, magnesium (Mg) and nitrogen (N). In our experiment, the control group of plants exhibited a well-defined circadian rhythm of optical transmission. Conversely, the group with withheld Mg and N displayed a modified circadian rhythm characterized by increased amplitude and enhanced transmission. When compared to the control group, this setup enabled us to rapidly detect nutrient deficiencies. After a few days, we supplied the nutrient-deficient group with a complete nutrient solution. Furthermore, we observed that, after a couple of days of administering the complete nutrient solution, the plants successfully restored a regular circadian rhythm. This finding instigates further investigation to determine the latest point at which the reintroduction of missing nutrients enables the plant to regain its natural circadian rhythm. Moreover, our future work will explore these boundaries, extending our research to other plant species.

11-4

Generating mesoporosity in zeolite 13X by applying mild alkaline treatment with urea solution

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Because of unique set of properties, zeolites are excelent adsorbers, catalysts and ion-exchangers widely used for various industrial applications. Nevertheless, these crystalline aluminosilicate materials posses micropores which cause steric and diffusion limitations inside the zeolite crystals. To overcome these problems, another level of porosity can be introduced in zeolitic structure either by synthetic or post-synthetic approach. Zeolites which show meso- and macro-porosity in addition to micro-porosity are hierarchically porous materials characterized by improved mass transfer, diffusion and adsorption performance as well as better access to the active sites. In order to produce hierarchical zeolite in sustainable way, post-synthetic alkaline treatment of zeolite 13X with aqueous urea solution was investigated. Urea was chosen as nontoxic and very affordable substance in terms of price and quantity, in accordance with the green chemistry concept. The zeolites 13X procured from the two manufacturers, regional Alumina (Zvornik, Bosnia and Hercegovina) and well established Union Carbide (Huston, Texas), were modified in the hydrothermal conditions, whereby the mass ratio of zeolite:urea was varied (1:1 and 1:3), as well as the heating time (12 h and 24 h). X-ray difraction, Fourier transform infrared spectroscopy, scanning electron microscopy and low temperature nitrogen adsorption were used for characterisation of the prepared materials. Eventhough applied alkaline treatment had influence on cristalinity of zeolite 13X (crystal structure was partially changed in the case of 0.22 mol/dm^3 urea solution, and significantely destroyed for 0.67 mol/dm^3 urea solution) it enables the introduction of mesopores into the structure. Nitrogen adsorption results clearly indicate the formation of mesopores, with simultaneous distruction of micropore structure. For both starting 13X zeolites treated with 0.67 mol/dm^3 urea solution for 24 h wide single monomodal pore size distrubution of generated mesopores was detected with center at about 12 nm. The concentration of urea solution had more effect on modification of crystal structure than heating time. Zeolite 13X manufactured by Union Carbide showed greater structural stability than zeolite manufactured by Alumina.

11-5

A fast and efficient synthesis of gamma rays dosimeters based on metalophthalocyanines

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The area of radiation protection has gained significant relevance due to the fast advancement of radiation technology and its utilization in scientific research. In order to meet the low doses of nuclear radiation, such as gamma (γ)-rays, development of great fineness, stable, and reliable sensors are required. The heterocyclic compounds known as metallophthalocyanines (MPcs) won considerable research interest owing to their exceptional thermal, chemical and photo-stability, and long wavelength absorption compatible with biological window, spreading their potential applications in technology and medicine. As a result, finding the ideal method for creating such molecules is always in the spotlight. In this work, we designed a novel and efficient microwave-assisted synthetic method for preparation of innovative sensor materials base on MPcs (M = Zn, Mn or Fe). A zinc phthalocyanine has been evaluated as model compound in preparing ZnPc/PVA composites as a new, effective chemical-based dosimeter for low-dose measurement of γ-rays within the dose range from 1-25 kGy. A microwave-enhanced synthetic approach has been evaluated as an impressive chemical-based dosimeter designer. A modest decrease in absorbance intensity, followed by color bleaching in the dose range of 1-25 kGy, enabled the preparation of ZnPc/PVA composites as fine, glossy surface films with impressive application in gamma-ray dosimetry.

Acknowledgment: The research was funded by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia (grant number 451-03-47/2023-01/200017).

11-6

The influence of the pre-deformation and post-deformation process on hardness and microstructure of the the EN AW-7075 aluminum alloy

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The study investigates the effect of thermomechanical treatment on the hardness and microstructure of EN AW-7075 aluminium alloy. The alloy was subjected to solution heat treatment at 480 °C for 1 hour, followed by quenching in ice water. One group of samples were subjected to cold plastic deformation at different deformation degrees by rolling, each followed by ageing at 150 °C for 30 min in order to achieve pre-deformation state (Temper T8). Another group of samples were aged at same temperature, at first, and then cold rolled in order to achieve post-deformation state (Temper T9). Leeb hardness was measured and microstructure was examined using optical microscopy. Results were interpreted for both states and compared. Significant changes in the properties of the alloy were observed. In pre-deformed state, lower deformation degrees, up to 10%, have a limited impact on hardness due to the partial elimination of previously introduced deformation, during the ageing process. Increasing deformation up to 40% results in notable increase in hardness due to increase in dislocation density and possible altering the precipitation kinetics. It is known that pre-deformation process produces suitable spots for secondary phases nucleation during precipitation. In the post-deformation state, a more pronounced increase in hardness is observed with increase of cold plastic deformation, since deformation strengthening occurred after ageing. At deformation degrees greater than 20%, deformation is unsuitable due to the appearance of macroscopic cracks. Both states exhibit an oriented microstructural change with elongated grains and the presence of secondary phases, underscoring the importance of deformation in defining the alloy's structure. These findings help understanding behaviour of given alloy at various regimes of thermomechanical treatment.

Acknowledgement: The research presented in this paper was done with the financial support of the Ministry of Education. Science and Technological Development of the Republic of Serbia. Within the funding of the scientific research work at the University of Belgrade. Technical Faculty in Bor. according to the contract with registration number 451-03-47/2023-01/200131. I would also like to express my gratitude to the professor Uroš Stamenković from University of Belgrade, Technical faculty in Bor for his helpful guidance and valuable advice.

12-1

Utilization of carbon fiber in the context of microbial fuel cell systems

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The paramount challenge of the 21st century lies in the profound energy demands imposed by contemporary society. The utilization of energy derived from non-renewable sources, notably coal, oil, and their byproducts, is intrinsically associated with grave environmental repercussions, primarily manifested in the form of pollution. The notion of fuel cells stands as a prospective resolution to this problem, offering a sustainable avenue for energy production devoid of environmentally adverse emissions. The aim of this research was to explore the potential of carbon cloth electrodes in the Microbial Fuel Cell (MFC) system. To create a microbial fuel cell, river sediment was utilized as the medium, sandwiched between two carbon cloth electrodes (R&G, Great Britain) with an electrode surface area of 82.5 cm^2. The system is designed to measure the open circuit voltage of the MFC, as well as the voltage across a series of external resistors that are progressively connected to the MFC. To achieve this, resistors that cover the 1 kΩ - 10 MΩ range are mounted on a breadboard (Velleman SD35N), while voltages are measured using a multimeter (PeakTech 2025). Using Ohm's law, the generated current is later calculated. The experimental investigation extended over ten days, during which voltage measurements were conducted daily. Analysis of the experimental findings revealed that the MFC employing a carbon cloth electrode exhibited noteworthy power generation capabilities. Notably, on the eighth day of the experiment, a peak current density of 0.27 mA/cm^2 was attained, surpassing previous outcomes achieved with MFC configurations utilizing inox electrodes[3]. These empirical observations lead to the inference that carbon cloth represents a superior material for electrode construction, particularly in performance in the context of power generation.

12-2

Polycrystalline nickel modified with rhodium as an effective electrocatalyst for hydrogen-based energy conversion technologies

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The electrode reactions of hydrogen and oxygen are of utmost importance to the technology of water electrolysis and fuel cells. Thus, developing advanced electrocatalysts is essential for meeting the energy needs of modern society. The work aimed to consider the potential of rapid galvanic displacement as a strategy for the design of advanced electrocatalysts and to examine the electrocatalytic activity of polycrystalline nickel electrodes modified with rhodium for hydrogen and oxygen evolution reactions (HER/OER), as well as for hydrogen oxidation reaction (HOR) and oxygen reduction reaction (ORR) in an alkaline media. Modification of the surface of the nickel electrode involves a simple and quick procedure of galvanic displacement using a concentrated acidic solution of Rh^{3+} ions. Based on the assessed HER and OER overpotentials and the low values of Tafel slopes, the results show significant enhancement of the electrocatalytic activity for these reactions on rhodium-modified electrodes. In contrast to pure nickel, the rhodium-modified nickel electrode shows remarkable electrocatalytic activity for HOR and greatly improved activity for ORR. However, its HOR and ORR performances are below the electrocatalytic activity of polycrystalline platinum electrodes. This finding can be attributed to the detrimental role of semiconducting Rh_2O_3 formed on the surface, which pertains to the HOR and ORR-operating potentials. In contrast, OER occurs at higher potentials where conductive RhO_2 is formed. This research provides insight into the mechanisms underlying the improved electrode kinetics observed at rhodium-modified nickel electrodes and contributes to the understanding of the development of efficient and cost-effective electrocatalysts for renewable energy technologies.

Acknowledgment: This work is supported by the Serbian Ministry of Science, Technological Development, and Innovation (451-03-47/2023-01/200146). The theoretical computations were enabled by resources provided by the National Academic Infrastructure for Supercomputing in Sweden (NAISS) at the NSC center of Linköping University, partially funded by the Swedish Research Council through grant agreement no. 2018-05973.

12-3

Perspective of Ni-Sn modified Ni foams in industrial scale alkaline water electrolysis

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Reaching climate neutrality by 2050. is one of the major goals that EU countries have set. One route to achieve European Green Deal goals is to produce green hydrogen through water splitting powered by renewables. In principle water electrolysis can be done in four types of reactors - alkaline, anion & proton exchange membrane, and solid-oxide electrolyzers. During the past few years, cells with anion exchange membranes have received considerable attention. However, just the proton exchange membrane and the alkaline water electrolyzers have reached commercial maturity. Owing to its ease of scalability, and the abundance of materials used for electrode manufacturing, alkaline water electrolysis is favored. Our research group has established optimal electrodeposition conditions to produce highly efficient hydrogen evolution catalyst coated Ni foam. Ni-Sn coated Ni foams were first tested in an H-cell both in 1M and 30% KOH at elevated temperature. Recorded low overpotentials (<100 mV) at -1000 mA cm^{-2} suggest that these electrodes could be promising cathodes for large scale application. Based on preliminary results in H-cell, modified Ni foams were further tested in zero-gap arrangement, where they exhibited good stability and higher heating value efficiency of 74%.

Acknowledgements: This work was supported by the Federal Ministry of Education and Research – Germany, through the WBC2019 call – project NOVATRODES 01DS21010, and by the Ministry of Education, Science and Technological Development of the Republic of Serbia (Contract No. 451-03-47/2023-01/200135).

12-4

Ni-MoO_2 as electrocatalyst for hydrogen evolution reaction

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Taking into consideration global pollution caused by transforming fossil fuel into energy, it is necessary to make a transition to cleaner energy source. Hydrogen is a promising candidate, due to the fact the production can be carried out through electrolysis using renewable energy, and also conversion of hydrogen to energy leaves no pollutants. Zero-gap flow electrolyzers are usually used for hydrogen production on industrial level, in alkaline enviroment. In this type of systems electrodes should be porous (for better electrolyte flow), and the role of electrocatalyst can be carried out by earth abundant metals. Our research group uses Ni foam with open-pore structure and average pore size of 450 μm as a substrate on which Ni was electrodeposited along with MoO_2 particles. In order to find optimal deposition conditions, a lot of parameters were varied such as current density, size of the MoO_2 particles and their concentration, deposition bath and method of mixing the solution. On such prepared electrodes activity for HER was investigated in H-cell in 1M KOH at room temperature. The best samples were characterized by SEM and EDS analysis and tested in a zero-gap flow electrolyser where 8M KOH (70 °C) was used as electrolyte. In addition, preliminary stability tests were conducted and showed improvement of activity over time.

Acknowledgements: This work was supported by the Federal Ministry of Education and Research – Germany, through the WBC2019 call – project NOVATRODES 01DS21010, and by the Ministry of Education, Science and Technological Development of the Republic of Serbia (Contract No.451-03-47/2023-01/200135).

12-5

The influence of $ZnCl_2$ on the capacitance of hydrothermally synthesized vine shoots-derived carbon

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Biomass poses both a challenge and an opportunity for the country's economy. The waste materials of a complex nature require specific management plans that are sustainable economically and environmentally. On the other hand, via different conversion routes, this feedstock can be converted into a number of useful raw materials. This study investigates vine shoots as a resource for high-quality carbonaceous electrode material. Since activation with $ZnCl_2$ was found to increase the specific capacitance of carbon, this study examines the co-activation effect with hydrothermal carbonization. The feedstock is carbonized at 200 °C in a hydrothermal reactor independently (HTC) and with $ZnCl_2$ as an activating agent (HTC_$ZnCl_2$). To increase the degree of carbonization, samples were placed in an inert atmosphere furnace and heated at 700 °C (HTC700, HTC_$ZnCl_2$_700). The obtained materials were characterized by FTIR Spectroscopy, XRPD, Elemental analysis, TGA/DSC. To investigate their electrochemical behaviour, Cyclic Voltammetry was performed in aqueous electrolytes of different pH. Specific capacitance decreased from 97 F g^{-1} in HTC700 to 75 F g^{-1} at 20 mV s^{-1} in KOH solution upon the addition of $ZnCl_2$. $ZnCl_2$ activator addition proved to be ineffective for capacitance increase. In conventional aqueous electrolytes, HTC700 showed good capacitive behavior making it favorable for application in aqueous supercapacitors.

Acknowledgment*:* This work is sustained by the NATO Science for Peace and Security (SPS) Programme (project G5836-SUPERCAR). We thank the CEEPUS network for the mobility to the Institute of Chemical and Energy Engineering, University of Natural Resources and Life Sciences, Vienna, Austria.

12-6

Hydrothermal carbonization of olive mill waste to electrode materials

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Hydrothermal carbonization (HTC) is a promising method for transforming high-moisture waste biomass into valuable resources. Here we propose a hydrothermally assisted synthesis of bio-waste-derived activated carbon which can be used as an electrode material for aqueous supercapacitors. The procedure initiates with the olive mill waste undergoing hydrothermal carbonization, at a consistent temperature and pressure. The obtained hydrochar is further mixed with different chemical activators and treated at higher temperature in an inert atmosphere, yielding several activated carbon materials (ACs). To assess their properties, the electrical conductivity of the resulting ACs was measured and the materials were structurally characterized by Fourier-transform infrared spectroscopy (FTIR) and X-ray powder diffraction (XRPD). These properties are correlated with the electrochemical behavior of the materials in aqueous acidic, neutral and alkaline electrolytes, investigated by cyclic voltammetry and chronopotentiometry. Prepared materials showed the best specific capacitances in alkaline electrolyte (6 M KOH) reaching ≈180 F g^{-1} at the scan rate of 20 mV s^{-1}.

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

13-1

Environmentally friendly cell with a rechargeable CF/AgCl-PPy cathode

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A rechargeable cathode composed of functionalized CF, silver chloride, and polypyrrole was employed in the construction of a relay cell with a magnesium alloy as anode material and a NaCl electrolyte. Electrochemical methods were used to examine system parameters, particular energy, power, and capacity. The reported values of cell specific energy ranging from 120 to 32 Wh kg-1 and specific powers ranging from 52 to 450 W kg-1 show that the presented system has the potential to be exploited as a lifeboat power source.

13-2

The effect of homogenization conditions on microstructure and recrystallization behavior of AA5182 alloy

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There is renewed interest in microstructure development at the different stages of the thermo-mechanical processing (TMP) of the 5xxx series aluminum alloys due to the increased demand for sheet material with excellent mechanical properties and formability. This study investigates how homogenization conditions affect the processes of dissolution and precipitation of secondary phases and, further down the processing line, the recrystallization behavior of Al-Mg alloy AA5182. The development of the microstructure from the as-cast state through different stages of TMP was followed by hardness and electrical resistance measurements as well as optical and scanning electron microscopy. As-cast alloy had a dendritic microstructure with Mg_2Si and Fe/Mn-containing microconstituents. During homogenization at temperatures below 500 °C, partial coagulation of Mg_2Si microconstituents as well as Mg_2Si precipitation at the interfaces of Fe/Mn-based microconstituents and as dispersoids occurred. Besides, fine Mn-based dispersoids precipitated in the dendrite cores. Treatment above 500 °C resulted in coagulation and, for a longer treatment time, almost complete dissolution of the Mg_2Si phase. After homogenization for shorter times, i.e., 4-16 h at 550 °C, coarse rod-like Al_6(Mn, Fe) dispersoids were observed in the regions close to the interdendritic boundaries. Extending homogenization time resulted in their coarsening and globularization and, finally, dissolution. In dendrite centers, much finer Mn-based dispersoids precipitated, which coarsen with extending homogenization time. Lab hot-rolling was conducted on the samples that underwent various homogenization treatments. It was found that the recrystallization degree and grain morphology are strongly affected by homogenization conditions. Homogenization at low-temperature (16 h/ 490 °C) or for a short time (4 h/550 °C) resulted in a partial recrystallization. Samples homogenized at 550 °C for 16 h or longer appeared recrystallized with only a few long deformed grains in the sheet center, although homogenization with very long treatment times (96 h) resulted in coarser grains.

Acknowledgement: This work was supported by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia (Contract No. 451-03-47/2023-01/200135).

13-3

Geopolymerisation of the kaolin from Bosnia and Herzegovina: Synthesis, characterization and potential application in high-tech ceramics

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The geopolymerization of aluminosilicate materials in alkaline environments is a complex physicochemical process that greatly influences engineering performances. The name "geopolymer" comes from the fact that the raw materials are mainly minerals of geological origin. In this case, kaolin clay from two deposits in Bosnia and Herzegovina was used. Kaolin deposits in the territory of this country are either completely unused or used only for the production of ceramic tiles, which leads to intensive research of this material in its potential application in geopolymers that are not only used in construction as an advanced substitute for cement, but also as a highly resistant material for fire protection in aviation or as a coating with the property of excellent thermal insulation, but also as a great solution for acoustic protection. This paper will be based on the characterization and synthesis of geopolymer mass made of kaolin clay, and on the consideration of potential applications. Geopolymers exhibit excellent mechanical and physical properties, such as low density, good chemical, fire, and thermal resistance and high mechanical strength. Therefore, they are widely applied in various fields as new materials with high-tech applications, from civil engineering to medical purposes.

13-4

Dependence of alumina/ascorbate oxidase biosensor electrocatalytic activity on alumina type

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Biosensors have emerged as indispensable tools across various disciplines, facilitating real-time monitoring of specific biomolecules. Within this context, a biosensor system integrates alumina, a versatile material, with ascorbate-oxidase, enabling the electrocatalytic detection of ascorbic acid. This study investigates the influence of different alumina types on the electrocatalytic activity of alumina/ascorbate-oxidase biosensors. The electrocatalytic performance of these biosensors critically hinges on the properties of the alumina substrates. Specifically, two distinct alumina variants were examined: aluminum oxide trihydrate (referred to as "T") and anhydrous (referred to as "G"). Biosensors were meticulously constructed by immobilizing ascorbate oxidase onto these designated substrates. Electrochemical experiments unveiled marked disparities in the electrocatalytic performance of the biosensors, contingent on the type of alumina used. Cyclic voltammetry and square wave voltammetry were employed to assess electrocatalytic activity. The outcomes demonstrated that G alumina exhibited the highest electrocatalytic activity. In contrast, T alumina displayed diminished electrocatalytic activity due to its reduced surface area, mainly ascribed to the presence of surrounding water molecules. Besides electrochemical characterization, the alumina substrates underwent analysis via Fourier Transform Infrared Spectroscopy and Electron Paramagnetic Resonance. After determining the more favorable alumina variant, an optimization test was initiated, and the calibration curve generation process commenced. This investigation underscores the pivotal role of alumina in shaping the electrocatalytic performance of biosensors, exerting significant influence over sensitivity, selectivity, and stability. An understanding of these effects is imperative for optimizing biosensor design and enhancing their utility in diverse fields. Future research endeavors may further explore alternative alumina modifications and their repercussions on biosensor performance.

13-5

Influence of chemical and mechanical pressure on luminescence properties of Cr^{3+}-activated near-infrared phosphors

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Investigating the optical properties of inorganic compounds doped with transition metals is essential in high-pressure studies using the diamond anvil cell. By exposing the phosphor material to high pressure, we directly influence the interaction of the crystal environment to luminescent centres and cause significant changes in the studied systems' energy structures. The overall conclusion from the structural point of view is the same effect that mechanical pressure can also be observed when chemical pressure is applied. Namely, incorporating the ion with a bigger ionic radius in the crystal lattice causes an increase in the atomic distance in the crystal, decreasing the crystal field strength around the ion. Opposite, incorporating the ion with a smaller ionic radius causes a decrease in the atomic distance in the crystal lattice, increasing the crystal field strength. In this study, we aim to compare the changes in the luminescence for two reference series of samples: $Ga_2Al_xO_3:0.02Cr^{3+}$ (GAOC) and $Ga_{2-x}Sc_xO_3:Cr^{3+}$ (GSOC). We found that GAOC has qualitatively the same, while GSOC has different behaviour in the chemical and mechanical pressure dependences of the luminescence properties. In the case of Al, we can consider it as ion substitution in the neighbour unit cell, which changes the crystal properties like mechanical pressure dose. When Ga_2O_3 is co-doped with the Sc ions, it causes lattice distortion in the Cr^{3+} local environment, and by applying pressure for GSOC, we reduce the volume of the cell, but we cannot reverse the distortion caused by the co-doping.

13-6

Utilizing absorption spectroscopy for investigating radiochromic films in radiation dosimetry

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Radiochromic films have emerged as valuable tools in radiation dosimetry, with GafChromic® EBT3 (External Beam Therapy 3) film garnering significant attention due to its high sensitivity and minimal energy dependence. Understanding the optical properties of radiochromic films is crucial for the accuracy and reliability of dose measurements. This study delves into the intricate details of the EBT3 film absorption spectrum, establishing a clear relationship between its composition and the delivered radiation dose. Additionally, the study provides a model for estimating the spectrum's composition and suggests a novel dose specifier with opportunities to achieve densitometer-independent calibrations. Radiochromic films were irradiated with doses ranging from 1 Gy to 10 Gy using a Cobalt-60 Gamma Knife unit. The irradiated films underwent spectral analysis using a UV-Vis spectrometer. Absorption spectra were measured 72 hours after irradiation, capturing a region between 420-700 nm, and the resulting spectra were decomposed using Lorentzian profiles. Characteristic absorption bands were identified by decomposing the obtained spectra into their constituent Lorentzian components. All profiles remain stable within 5 nm of the peak position and exhibit consistent dose-related changes. The relative changes in absorption at the 583 nm and 635 nm absorption bands demonstrated a logistic response, in line with predictions from polymerization models. The observed changes in absorption bands suggest the potential use of relative band absorption as a parameter for dose identification. Insights gained from this study have the potential to enhance dose measurement accuracy in radiation therapy applications involving radiochromic film, ultimately improving treatment planning and quality assurance.

14-1

Characterization and hydrogen evolution on Pt/nanoplatelets

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Finding suitable catalysts for hydrogen evolution reaction (HER) is key for economic production of hydrogen for use in fuel cells. Reducing the amount of expensive noble metals that are used is one of the ways for obtaining such catalysts. Various combinations of different noble metals and various carbon supports have been studied. In this work nanoplatelets (GNP) was used as a support and on it Pt nanoparticles were electrochemically deposited in sub monolayer nanoislands. Obtained Pt/GNP electrode was characterized by X ray photoelectron spectroscopy (XPS) and scanning electron microscopy (SEM) while its electrocatalytic activity was investigated by cyclic voltammetry (CV), linear sweep voltammetry (LSV) and chronoamperometry . XPS analysis showed that the atomic percentages of Pt in Pt/GNP was 1.3% for electhrochemical deposition and 0.3% for spontaneous deposition, respectively. SEM micrographs of Pt/GNP electrode surface showed that Pt nanoparticles occupy mostly the edges GNP support, while elemental maping confirms the distribution of Pt, C and O over the surface of the electrode. Pt/GNP electrode has shown remarkably good performance for HER reaction in 0.5 M H_2SO_4 acid solution. Outstanding HER activity was achieved, showing the initial potential close to the equilibrium potential for HER and of -0.003 V and a low Tafel slope of about -30 mV/dec. The chronoamperometric measurement performed over 180 min for hydrogen evolution at the constant potential indicates good stability and durability.

14-2

Investigation of varied dip-coating methods for the deposition of TiO_2 blocking layer of the photoanode of dye-sensitized solar cells

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Among various renewable energy sources, solar energy is considered one with the highest potential for exploitation. Solar cells are understandably seen as promising future solutions for the world's energy deficiency. Fabrication of the Dye-Sensitized Solar Cells (DSSC) uses easy and inexpensive technology, which doesn't require toxic materials, making them ecologically suitable. Furthermore, they offer ample opportunities for improvement, which would pave the way to higher efficiency. The most important part of these cells is the photoanode, which serves as the absorber of solar energy. The photoanode usually consists of two types of semiconductor layers (blocking and mesoporous), usually titanium dioxide (TiO_2) deposited on transparent conductive oxide (TCO), and adsorbed dye molecules. Absorbed photons excite electrons in the dye molecules, which then get injected into the semiconductor, and then into TCO. The blocking layer plays a dual role, preventing unfavorable recombination processes and ensuring strong adhesion between the mesoporous layer and TCO. The aim of this work is to compare different parameters of the dip-coating method for preparing an efficient blocking layer of TiO_2. By varying parameters such as concentrations of $TiCl_4$ precursor in water, temperature, and dip-coating duration, as well as the position of the sample (vertically or horizontally) blocking layers were deposited, in two different manners. Through detailed optical, morphological, and electrochemical characterization of the TiO_2 blocking layers, the best samples were chosen for the manufacturing of the solar cells. Deposited layers should have assured compactness, without excessively endangering the transparency of the photoanode, while maintaining good electrical conductivity. Therefore, UV-VIS spectroscopy, Atom Force Microscopy, Electrochemical Impedance Spectroscopy, and Cycle Voltammetry have been used for the purpose of this research. Ultimately, solar cells are characterized by linear sweep voltammetry to obtain their efficiency.

14-3

Spin-coated TiO2 thin films: Fabrication and characterization study

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In order to meet the ever-increasing global demand for energy and the increasingly rigorous environmental standards, humankind is turning to renewable energy sources, of which the Sun has the greatest potential. Dye-sensitized solar cells are immensely attractive due to their simple and low-cost fabrication process. It has been shown that a TiO_2 blocking layer plays a crucial role in the final efficiency of these cells. In our research, we investigated influences of solute concentration (40, 120, and 240 mM), temperature (at 30 °C, 50 °C, and 70 °C) and heating duration (20, 40, and 60 minutes) on characteristics of TiO_2 thin films on glass substrates prepared from $TiCl_4$ precursor using the spin-coating method. UV-Vis spectroscopy was used to measure the transparency of the prepared samples, while atomic force microscopy was performed to determine the compactness as well as the roughness of the prepared samples. It turned out that higher concentration solutions require higher temperatures for achieving film compactness. On the other hand, increasing temperature leads to a reduction in the transparency of the TiO_2 thin films, followed by increased surface roughness. Furthermore, we examined the applicability of a simple analytical formula based on spectral positions of interference fringes in reflectance spectra and real refractive index for determining ultrathin film thickness. For this purpose, TiO_2 thin films were deposited six times on the same Ti substrate, with reflectance spectra measured following each deposition. Our results based on computer simulations using the transfer matrix method highlight that the extinction coefficient can strongly affect the applicability of the method, but above all, exact knowledge of optical constants proves to be crucial for determining the film thickness of prepared samples. Therefore, the deployment of more advanced methods to determine both the thickness and the optical constants of ultrathin films is necessary.

14-4

Metal complexes as potential new materials for dye-sensitized solar cells: Synthesis and characterization of Zn(II) complex with asymmetric Schiff base of 2,6-diacetylpyridine

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The results of our earlier research showed that complexes of 3d- and 4d-metals with N-heterocyclic ligands have broad absorption spectra and are excellent light-harvesting materials, which is why they can be good materials for enhancing the sensitivity of the third generation of solar cells – dye-sensitized solar cells (DSSCs). Research has also shown that metal complexes contribute to the stability and photovoltaic performance of DSSCs. This paper describes the synthesis and characterization of Zn(II) complex with the asymmetric Schiff base of 2,6-diacetylpyridine. As C=N bonds are most often responsible for the fluorescent and luminescent properties of complexes, further investigation of such properties will lead to the investigation of the potential application of this compound in the field of described solar cells. The neutral Zn(II) complex was obtained by the template synthesis of $Zn(OAc)_2 \cdot 2H_2O$, the chloride salts of mono-2,6-diacetylpyridine-thiosemicarbazide and phenyl-hydrazine (1:1:1), in methanol. Used Schiff base has a role as N_3S tetradentate ligand. Zn(II) is located in the expectedly deformed square-pyramidal environment of the donor atoms of the ligand in the basal plane, and the chlorido coligand in the apical position. Experimental tests of the photoluminescent properties of this complex are underway.

14-5

The analysis of roof-integrated PV plant with the possible usage of battery energy storage system

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This paper describes the plans and goals of the European Union for reducing harmful CO_2 emissions and preventing climate change. The current state of electricity production from renewable sources in the European Union and Serbia is presented. In particular, the progress of the application of solar energy in the European Union was shown, while its solar potential was presented for Serbia. An overview of encouraging renewable energy sources was made, which would also involve citizens in the energy transition. The electricity purchase models defined by the Law on Renewable Energy Sources and High-Efficiency Cogeneration and the billing models are presented. Furthermore, the principle of converting solar radiation into electricity in a photovoltaic cell is explained, and the structure of the solar panel is presented. All energy storage options were considered, and it was determined which of them were applicable to the household and in what form. Optimization found that the battery is not currently profitable to observe in the model. A photovoltaic power plant's optimal power is 3,35 kW. The results of the analysis are shown in diagrams in which electricity production and profits are observed after the project is implemented. With the net current value and internal return rate, economic and financial flows of money were presented, and a project's costeffectiveness was proven on the basis of them. By increasing the price of electricity, the costeffectiveness increases as the increase in investment costs decreases, which is shown in the analysis of sensitivity.

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