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INSTITUTE OF TECHNICAL SCIENCES OF SASA

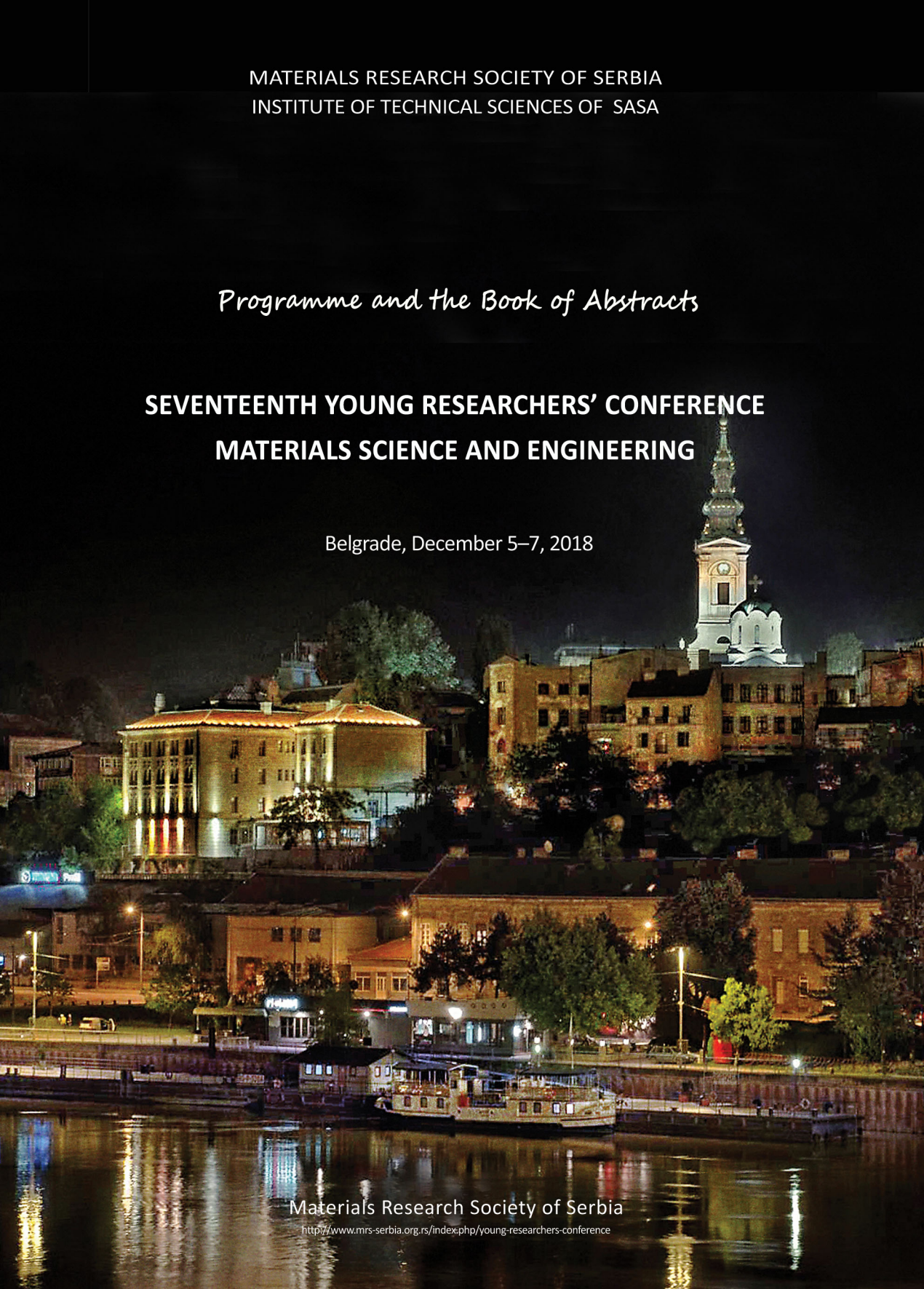
Programme and the Book of Abstracts

**SEVENTEENTH YOUNG RESEARCHERS' CONFERENCE
MATERIALS SCIENCE AND ENGINEERING**

Belgrade, December 5–7, 2018

Materials Research Society of Serbia

<http://www.mrs-serbia.org.rs/index.php/young-researchers-conference>



**SEVENTEENTH YOUNG RESEARCHERS' CONFERENCE
MATERIALS SCIENCE AND ENGINEERING**

December 5-7, 2018, Belgrade, Serbia

Program and the Book of Abstracts

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

November 2018, Belgrade, Serbia

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Program and the Book of Abstracts

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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
Nanostructured materials
New synthesis and processing methods
Theoretical modelling of materials

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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 2019.

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Programme
Seventeenth Young Researchers Conference
Materials Science and Engineering

Wednesday, December 5, 2018

09.00 – 09.30 Opening Ceremony

09.30 – 11.30 1st Session – Biomaterials I

Chairpersons: Prof. Dr. Bojana Obradović and Milena Radenković

09.30 – 09.45 Subcutaneous tissue reaction to collagen-based membranes of different origin

Milena Radenković¹, Sanja Stojanović^{1,2}, Jelena Živković^{1,2}, Vladimir Cvetković³, Žarko Mitić⁴, Shahram Ghanaati⁵, Stevo Najman^{1,2}

¹University of Niš, Faculty of Medicine, Scientific Research Center for Biomedicine, Department for Cell and Tissue Engineering, 18000 Niš, Serbia, ²University of Niš, Faculty of Medicine, Department of Biology and Human Genetics, 18000 Niš, Serbia, ³University of Niš, Faculty of Sciences and Mathematics, Department of Biology and Ecology, 18000 Niš, Serbia, ⁴University of Niš, Faculty of Medicine, Department of Pharmacy, 18000 Niš, Serbia, ⁵Medical Center Goethe-University Frankfurt am Main, Department for Oral, Cranio-Maxillofacial and Facial Plastic Surgery, FORM-lab, 60590 Frankfurt am Main, Germany

09.45 – 10.00 Antibiotic loaded bioactive orthopedic implant coating

Milena Stevanović¹, Ana Janković¹, Marija Došić², Maja Vukašinović-Sekulić¹, Vesna Kojić³, Vesna Mišković-Stanković¹

¹Faculty of Technology and Metallurgy, Karnegijeva 4, Belgrade, Serbia, ²Institute for Technology of Nuclear and Other Mineral Raw Materials, Bulevar Franš d'Eperea 86, Belgrade, Serbia, ³Oncology Institute of Vojvodina, Faculty of Medicine, University of Novi Sad, Put Dr Goldmana 4, Sremska Kamenica, Serbia

10.00 – 10.15 Production of composite hydrogels based on poly(vinyl alcohol) and β -tricalcium-phosphate for potential applications in bone tissue implants

Natalija Stojanović, Jasmina Stojkowska, Đorđe Veljović, Bojana Obradović

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

10.15 – 10.30 Characterization of porous alginate hydrogels with bioactive hydroxyapatite precursor particles for bone tissue engineering

Jovana Skenderija, Nataša Tomašević, Jasmina Stojkowska, Đorđe Veljović, Bojana Obradović

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

10.30 – 10.45 Development and optimization of the production procedure of biphasic scaffolds for osteochondral tissue engineering

Mia Radonjić, Jovana Zvicer, Bojana Obradović

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

10.45 – 11.00 Functional characterization of biphasic implants based on gellan gum and bioactive glass for osteochondral tissue engineering

Ilijana Kovrlija, Jovana Zvicer, Bojana Obradović

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

11.00 – 11.15 Processing of dental inserts based on nanostructured magnesium doped calcium-hydroxyapatite and their application as dental substitutes

Tamara Matić, Maja Ležaja Zebić, Giuma Ayoub, Vesna Miletić, Rada Petrović, Đorđe Veljović, Đorđe Janačković

¹University of Belgrade, Faculty of Technology and Metallurgy, Inorganic Chemical Technology, Karnegijeva 4, 11120 Belgrade, Serbia, ²University of Belgrade, School of Dental Medicine, DentalNet Research Group, Rankeova 4, Belgrade, Serbia

11.15 – 11.30 Temperature changes during light curing of conventional and “bulk-fill” dental composites

Jovana N. Stasić, Vesna Miletić

University of Belgrade, School of Dental Medicine, DentalNet Research Group, Rankeova 4, 11000 Belgrade, RS

11.30 – 11.45 Break

11.45 – 13.45 2nd Session – Biomaterials II

Chairpersons: Dr. Magdalena Stevanović and Dr. Tatiana Demina

11.45 – 12.00 Biodegradable microparticles as a scaffolds for cell therapy

Nenad Filipović,¹ Giuseppe Digilio,² Valeria Catanzaro,² Federico Capuana,³ Sergio Padovan,⁴ Juan C. Cutrin,³ Fabio Carniato,² Stefano Porta,³ Cristina Grange,⁵ Magdalena Stevanović¹

¹Institute of Technical Sciences of the Serbian Academy of Sciences and Arts, Knez Mihailova 35/IV, 11000 Belgrade, Serbia, ²Department of Science and Technologic Innovation, Università del Piemonte Orientale 11 “Amedeo Avogadro”, Viale T. Michel 11, I-15121 Alessandria, Italy, ³Department of Molecular Biotechnology and Health Science & Center for Molecular Imaging, University of Turin, Via Nizza 52, 10126 Torino, Italy, ⁴Institute for Biostructures and Bioimages (CNR) c/o Molecular Biotechnology Center Via Nizza 52, 10126 Torino, Italy, ⁵Department of Medical Sciences, University of Turin, Via Nizza 52, 10126 Torino, Italy

12.00 – 12.15 Structural analysis of antiradical activities of catecholamines

Jelica Ilić¹, Dušan Dimić², Jasmina Dimitrić Marković²

¹University of Belgrade, Institute of Chemistry, Technology and Metallurgy, Department of Catalysis and Chemical Engineering, Njegoševa 12, Belgrade, Serbia, ²University of Belgrade, Faculty of Physical Chemistry, Studentski trg 12/16, 11000 Belgrade, Serbia

12.15 – 12.30 Synthesis and controlled drug release of poly(N-isopropylacrylamide) based thermosensitive hydrogels and encapsulation with paracetamol

Dunja Arsenijević¹, Anamarija Nikoletić^{1,2}

¹Petnica Science Center, Serbia, ²Faculty of Chemistry, University of Belgrade, Serbia

12.30 – 12.45 Synthesis and characterization of genipin-crosslinked chitosan hydrogels

Ana Stanojević¹, Đurđa Vukajlović², Julie Parker², Katarina Novaković²

¹University of Belgrade, Faculty of Physical Chemistry, Belgrade, Serbia, ²Newcastle University, School of Engineering, Newcastle Upon Tyne, United Kingdom

12.45 – 13.00 Production optimization of nanocomposite microfibre hydrogels based on alginate, honey and silver nanoparticles

Milan Pavlović, Jasmina Stojkowska, Bojana Obradović

University of Belgrade, Faculty of Technology and Metallurgy, Department of Chemical Engineering, Belgrade, Serbia

13.00 – 13.15 Silver/poly(vinyl alcohol)/chitosan and silver/poly(vinyl alcohol)/chitosan/graphene hydrogels – electrochemical synthesis, silver release and antibacterial properties

Katarina Nešović¹, Ana Janković¹, Maja Vukašinović-Sekulić¹, Aleksandra Perić-Grujić¹, Vesna Kojić², Vesna Mišković-Stanković¹

¹University of Belgrade, Faculty of Technology and Metallurgy, Belgrade, Serbia,

²University of Novi Sad, Faculty of Medicine, Oncology Institute of Vojvodina, Sremska Kamenica, Srbija

13.15 – 13.30 Chitosan-g-oligolactide copolymers for regenerative medicine

Tatiana S. Demina^{1,2}, Ksenia N. Bardakova¹, Christian Grandfils³, Tatiana A. Akopova², Peter S. Timashev²

¹Institute for Regenerative Medicine, Sechenov University, Moscow, Russia, ²Enikolopov Institute of Synthetic Polymer Materials RAS, Moscow, Russia, ³Interfaculty Research Centre on Biomaterials (CEIB), University of Liège, Liege, Belgium

13.30 – 13.45 Characteristic of titanium dioxide - chitosan - hyaluronic acid systems interactions with DPPG membrane

Agata Gozdecka, Agnieszka E. Wiącek, Małgorzata Jurak

Maria Curie-Skłodowska University, Faculty of Chemistry, Department of Interfacial Phenomena, Lublin, Poland

13.45 – 14.45 Lunch break

14.45 – 16.45 3rd Session – Biomaterials III

Chairpersons: Dr. Đorđe Veljović and Klaudia Woźniak

14.45 – 15.00 The investigation of structural and morphological properties of starch coated Ni-Zn-ferrites

Marija Šuljagić¹, Dejan Jeremić², Ljubica Anđelković³, Predrag J. Vulić⁴, Aleksandar S. Nikolić¹

¹Faculty of Chemistry, University of Belgrade, Studentski Trg 12–16, 11000 Belgrade, RS,

²Innovation Center of the Faculty of Chemistry, University of Belgrade, Studentski Trg 12–16, 11000 Belgrade, RS, ³Department of Chemistry, IChTM, University of Belgrade, Studentski Trg 12–16, 11000 Belgrade, RS, ⁴Faculty of Mining and Geology, University of Belgrade, Djušina 7, 11000 Belgrade, RS

15.00 – 15.15 Novel pH sensitive degradable zwitterionic hydrogels based on poly(β -amino esters)

Vuk Filipović¹, Lidija Đokić², Jasmina Nikodinović Runić², Dejan Godevac¹, Simonida Tomić³

¹University of Belgrade, Institute of Chemistry, Technology and Metallurgy, Belgrade, Serbia,

²University of Belgrade, Institute of Molecular Genetics and Genetic Engineering,

³University of Belgrade, Faculty of Technology and Metallurgy, Belgrade, Serbia

15.15 – 15.30 Smart biocompatible and biodegradable hydrogel matrices based on natural and synthetic polymers

Marija M. Babić¹, Vuk V. Filipović², Simonida Lj. Tomić¹

¹University of Belgrade, Faculty of Technology and Metallurgy, Belgrade, Serbia,

²University of Belgrade, Institute of Chemistry, Technology and Metallurgy, Belgrade, Serbia

15.30 – 15.45 Fibroblasts' proliferation on collagen-based membranes of different origin – *in vitro* study

Sanja Stojanović^{1,2}, Milica Tomić², Žarko Mitić³, Stevo Najman^{1,2}

¹University of Niš, Faculty of Medicine, Department of Biology and Human Genetics, 18000 Niš, Serbia,

²University of Niš, Faculty of Medicine, Scientific Research Center for Biomedicine, Department for Cell and Tissue Engineering, 18000 Niš, Serbia

³University of Niš, Faculty of Medicine, Department of Pharmacy, 18000 Niš, Serbia

15.45 – 16.00 Studies on properties of lipid – peptide films on a polymer support

Klaudia Woźniak, Małgorzata Jurak, Agnieszka Ewa Wiącek, Kacper Przykaza
Department of Physical Chemistry-Interfacial Phenomena, Faculty of Chemistry, Maria Curie-Skłodowska University, 20-031 Lublin, Poland

16.00 – 16.15 Wetting properties of plasma activated and biocoated PEEK surfaces

Kacper Przykaza, Klaudia Woźniak, Agata Gozdecka, Małgorzata Jurak, Agnieszka Ewa Wiącek

Department of Physical Chemistry-Interfacial Phenomena, Faculty of Chemistry, University of Maria Curie-Skłodowska, Maria Curie-Skłodowska Sq. 3, 20-031 Lublin, Poland

16.15 – 16.30 Synthesis and characterization of bioactive glass doped with lithium and strontium ions

Jovana Dimitrijević¹, Đorđe Veljović¹, Rada Petrović¹, Željko Radovanović¹, Smilja Marković², Jelena Rogan¹, Aleksandra Dapčević¹, Suzana Dimitrijević Branković¹, Vesna Kojić³, Đorđe Janačković¹

¹Faculty of Technology and Metallurgy, University of Belgrade, Belgrade, Serbia, ²Institute of Technical Sciences of SASA, Belgrade, Serbia, ³Oncology Institute of Vojvodina, Sremska Kamenica, Serbia

16.30 – 16.45 Phase, morphological and statistical analysis of urinary stones from Serbian patients

Miljana Mirković,¹ Anja Dosen,¹ Branko Matović,¹ Suzana Erić,² Predrag Vulić,² Aleksandra Rosić²

¹Department of Material Science, Vinča Institute of Nuclear Sciences, University of Belgrade, Serbia, ²Department of Mineralogy and Crystallography, Faculty of Mining and Geology, University of Belgrade, Serbia

16.45 – 17.00 Break

**17.00 – 18.30 4th Session – Theoretical Modeling of Materials
Chairpersons: Prof. Dr. Igor Pašti and Ana Dobrota**

17.00 – 17.15 Design of novel oxygen reduction reaction electrocatalysts guided by systematic study of atomic adsorption on graphene through the Periodic Table of Elements

Igor A. Pašti,¹ Aleksandar Z. Jovanović,¹ Ana S. Dobrota,¹ Nemanja M. Gavrilov,¹ Börje Johansson,^{2,3} Natalia V. Skorodumova,^{2,3} Slavko V. Mentus,^{1,4}

¹University of Belgrade, Faculty of Physical Chemistry, Belgrade, RS, ²Uppsala University, Department of Physics and Astronomy, Uppsala, SE, ³KTH - Royal Institute of Technology, School of Industrial Engineering and Management, Department of Materials Science and Engineering, Stockholm, SE, ⁴Serbian Academy of Sciences and Arts, Belgrade, RS

17.15 – 17.30 DFT investigation of monoatomic catalysts supported by graphene substrates

Aleksandar Z. Jovanović, Igor A. Pašti

University of Belgrade, Faculty of Physical Chemistry, Studentski trg 12-16, 11158 Belgrade, Serbia

17.30 – 17.45 Doped graphene as an electrode material in novel metal-ion batteries: the importance of the oxidation level

Ana S. Dobrota,¹ Igor A. Pašti,^{1,2} Natalia V. Skorodumova^{2,3}

¹University of Belgrade, Faculty of Physical Chemistry, Belgrade, Serbia, ²KTH Royal Institute of Technology, Department of Materials Science and Engineering, School of Industrial Engineering and Management, Stockholm, Sweden, ³Uppsala University, Department of Physics and Astronomy, Uppsala, Sweden

17.45 – 18.00 Structural properties and antisite defect formation in monoclinic $\text{Li}_2\text{FeSiO}_4$ – a DFT aspect

Dragana D. Vasić Aničijević¹, Vladan J. Aničijević², Miloš D. Milović³

¹Vinča Institute of Nuclear Sciences, University of Belgrade, Mike Alasa 12-14, Belgrade, Serbia, ²Faculty of Physical Chemistry, University of Belgrade, Studentski trg 12-16, Belgrade, Serbia, ³Institute of Technical Sciences of SASA, Knez Mihailova 35/IV, 11 000 Belgrade, Serbia

18.00 – 18.15 Investigation of wave propagation in single crystals of heat-resistant nickel alloys

Elena Vladimirovna Tuch¹, Ekaterina Aleksandrovna Strebkova²

¹Institute of Strength Physics and Materials Science SB RAS, 2/4 Akademichesky Ave., Tomsk, 634055, Russia, ²National research Tomsk State University, 36 Lenina St., Tomsk, 634000, Russia

18.15 – 18.30 The effect of disorder on the density of electronic states of two-layer AB graphene

Nadezhda Bobenko,¹ Valery Egorushkin,¹ Nataliya Melnikova,² Alexander Ponomarev,¹ Leonid Barkalov,⁴ Anna Belosludseva^{1,3}

¹Institute of Strength Physics and Materials Science, Siberian Branch of the Russian Academy of Sciences, Tomsk, Russia, ²National Research Tomsk State University, the V.D. Kuznetsov Siberian Physical Technical Institute, Tomsk, Russia, ³Tomsk State University of Control Systems and Radioelectronics, Tomsk, Russia, ⁴Saint-Petersburg National Research University of Information Technologies, Mechanics and Optics, St. Petersburg, Russia

Thursday, December 6, 2018

09.00 – 11.15 5th Session – New Synthesis and Processing Methods I

Chairpersons: Dr. Smilja Marković and Željko V. Janičijević

09.00 – 09.15 Comparative properties of composite poly(lactic-co-glycolic acid)/poly(acrylic acid) implants synthesized using ultraviolet and gamma irradiation

Željko V. Janičijević^{1,2}, Ivica T. Vujčić³, Miloš Lj. Vujisić¹, Filip D. Radovanović²

¹University of Belgrade, School of Electrical Engineering, Bulevar kralja Aleksandra 73, 11120 Belgrade, Serbia, ²Institute of Technical Sciences of the Serbian Academy of Sciences and Arts, Knez Mihailova 35/IV, 11000 Belgrade, Serbia, ³University of Belgrade, Vinča Institute of Nuclear Sciences, Mike Petrovića Alasa 12-14, 11351 Vinča, Belgrade, Serbia

09.15 – 09.30 Determination of the effective diffusivity coefficients of naringin esters

Anđela M. Paunović¹, Ana D. Milivojević², Marija M. Čorović³

¹University of Belgrade, Faculty of Technology and Metallurgy, Belgrade, Serbia, ²University of Belgrade, Innovation Center, Faculty of Technology and Metallurgy, Belgrade, Serbia, ³University of Belgrade, Faculty of Technology and Metallurgy, Department of Biochemical Engineering and Biotechnology, Belgrade, Serbia

09.30 – 09.45 Enzymatic synthesis of naringin esters using natural oils as acyl donors

Teodora Arsenijević¹, Ana D. Milivojević², Marija M. Čorović³

¹University of Belgrade, Faculty of Technology and Metallurgy, Belgrade, Serbia, ²University of Belgrade, Innovation Center, Faculty of Technology and Metallurgy, Belgrade, Serbia, ³University of Belgrade, Faculty of Technology and Metallurgy, Department of Biochemical Engineering and Biotechnology, Belgrade, Serbia

09.45 – 10.00 Tellurite glasses: potential transparent radiation shielding materials

Ali Erçin Ersundu, Miray Çelikbilek Ersundu, Volkan Akıllı, Orhan Kıbrıslı

Yildiz Technical University, Faculty of Chemical and Metallurgical Engineering, Department of Metallurgical and Materials Engineering, Istanbul, 34220, Turkey

10.00 – 10.15 Solvothermal synthesis of kaolinite nanoscrolls

András Kovács, Éva Kristófné Makó

University of Pannonia, Faculty of Engineering, Institute of Materials Engineering, Veszprém, Hungary

10.15 – 10.30 The influence of the chemical modifications on the AC specific electrical conductivity of the jute woven fabrics

Aleksandra M. Ivanovska¹, Dragana D. Cerović^{2,3}, Koviļjka A. Asanović¹, Mirjana M. Kostić¹

¹University of Belgrade, Faculty of Technology and Metallurgy, Department of Textile Engineering, Belgrade, Serbia, ²University of Belgrade, Faculty of Physics, Belgrade, Serbia, ³The College of Textile Design, Technology and Management, Belgrade, Serbia

10.30 – 10.45 Potential application of pharmaceutical waste: oxaprozin as corrosion inhibitor on aluminium alloy AA2024

Stefan Đokić¹, Bojan Božić², Branimir Grgur¹, Jelena Bajat¹

¹Faculty of Technology and Metallurgy, Karnegijeva 4, 11120 Belgrade, Serbia, ²Institute of Physiology and Biochemistry, Faculty of Biology, University of Belgrade, Studentski trg 16, 11000 Belgrade, Serbia

10.45 – 11.00 Investigation of the effect of different surface preparation on X42CR13 prior to PVD coating on wear resistance

Shiraz Ahmed Siddiqui, Andrea Szilágyiné Biró, Maria Berkes Maros

University of Miskolc, Hungary, Institute of Materials Science & Technology

11.00 – 11.15 Investigation of nanomechanical properties of chemically tempered glasses

Ahmet Caner Kayaalp^{1,2}, Berkel Kayacan^{1,2}, Nahide Özben², Lukas Simurka², İlkey Sökmen², Ali Erçin Ersundu¹, Miray Çelikbilek Ersundu¹

¹Yildiz Technical University, Department of Metallurgical and Materials Engineering, Faculty of Chemical and Metallurgical Engineering, Istanbul, 34220, Turkey, ²Şişecam Science and Technology Center, Şişecam Str. No:2 Çayirova, Kocaeli, Turkey

11.15 – 11.30 Break

**11.30 – 13.30 6th Session – New Synthesis and Processing Methods II
Chairpersons: Dr. Nadica Abazović and Ardak Karagulanova**

11.30 – 11.45 Production of alkali activated cements using a new industrial waste source

Ida Balczár, Tamás Korim

University of Pannonia, Faculty of Engineering, Institute of Materials Engineering, Veszprém, Hungary

11.45 – 12.00 Synthesize graphene foam as anode materials for lithium ion batteries

Bahareh Bakhtiari, Rokhsareh Bakhtiari, Alp Yurum, Selmiye Alkan Gursel

Sabancı University Nanotechnology Research and Application Center (SUNUM), Tuzla, Istanbul, Turkey 34956

12.00 – 12.15 Technological restrictions at 3D printing with Zortrax M200 3D printer

Emanuel B. Scutaru¹, Georgiana Vetrice¹, Ivan Knežević², Mircea V. Drăgoi¹, Valentin M. Stamate¹

¹*Department of Manufacturing Engineering, Faculty of Technological Engineering and Industrial Management, Transilvania University of Braşov, Braşov, Romania,* ²*Department of Mechanical Engineering, Faculty of Technical Sciences, University of Novi Sad, Novi Sad, Serbia*

12.15 – 12.30 Alkali activated cement foams as catalyst supports

Adrienn Boros, Tamás Korim, Ida Balczár

University of Pannonia, Faculty of Engineering, Institute of Materials Engineering, Veszprém, Hungary

12.30 – 12.45 Possibilities of destruction of hazardous waste piralen

Oliver Dimitrijević, Miodrag Šmelcerović

Higher Medical School of Professional studies "HIPOKRAT", Bujanovac, Serbia

12.45 – 13.00 Deposition of bioactive coatings onto polylactide materials: comparison of methods

Tatiana S. Demina^{1,2}

¹*Enikolopov Institute of Synthetic Polymer Materials RAS, Moscow, Russia,* ²*Institute for Regenerative Medicine, Sechenov University, Moscow, Russia*

13.00 – 13.15 The study of the applicability of flotation agents based on derivatives of oxane for an enrichment of fine coal particles

Ardak Karagulanova¹, Dmitriy Shekhirev², Zhanibek Asylhanov³, Sergey Kalugin³, Olesya Tyumentseva¹, Tlek Ketegenov¹

¹*Al-Farabi Kazakh National University, Scientific Technology Park, Almaty, Kazakhstan,* ²*National university of science and technology MISIS, SRI for New Chemical Technologies and Materials*

13.15 – 13.30 Hydrogenation of exhaust resource storage of explosives nitroaromatic series with the purpose of their utilization

Alexey V. Safonov, Maxim V. Kuznetsov

All-Russian Research Institute on Problems of Civil Defense and Emergencies of Emergency Control Ministry of Russia (EMERCOM), Moscow, Russian Federation

13.30 – 14.30 Lunch break

14.30 – 16.45 7th Session – Materials for High-technology Application I
Chairpersons: Dr. Vuk Radmilović and Dr. Deepak Venkateshvaran

14.30 – 15.00 Thermoelectrics and spintronics of organic semiconductors

Deepak Venkateshvaran¹, Shu-Jen Wang¹, Martin Statz¹, Riccardo Di Pietro², Henning Sirringhaus¹

¹*Cavendish Laboratory, University of Cambridge, JJ Thomson Avenue, Cambridge, CB3 0HE, United Kingdom,* ²*Hitachi Cambridge Laboratory, JJ Thomson Avenue, Cambridge, CB3 0HE, United Kingdom*

15.00 – 15.15 Welded silver nanowires as transparent electrodes in optoelectronics

Vuk V. Radmilović¹, Peter Ercius², Colin Ophus², Erdmann Spiecker³, Velimir R. Radmilović⁴

¹*University of Belgrade, Faculty of Technology and Metallurgy, Innovation Center, Belgrade, Serbia,* ²*University of California, Molecular Foundry, National Center for Electron Microscopy, Berkeley, USA,* ³*Friedrich Alexander University, Department of Materials Science and Engineering, Institute for Micro- and Nanostructure Research, Erlangen, Germany,* ⁴*Serbian Academy of Sciences and Arts, Belgrade, Serbia*

15.15 – 15.30 Processing and characterization of Bi_{0.5}Na_{0.5}TiO₃ piezoelectric ceramics

Aleksandra Milojković¹, Andrea Nesterović¹, Jelena Vukmirović¹, Elvira Đurđić², Branimir Bajac³, Marija Milanović¹, Vladimir V. Srdić¹

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15.30 – 15.45 X-ray spectra and electronic structure of the Ca₃Ga₂Ge₃O₁₂ compound

Volodymyr Truba, Ivan Shcherba

Lviv National University of Ivan Franko, Faculty of Physics, Lviv, Ukraine

15.45 – 16.00 Synthesis and characterization of Na_{0.4}MnO₂ as cathode material for aqueous sodium-ion batteries

Lazar Rakočević¹, Mirjana Novaković², Jelena Potočnik², Dragana Jugović³, Ivana Stojković Simatović¹

¹*University of Belgrade, Faculty of Physical Chemistry, Belgrade, Serbia,* ²*University of Belgrade, Vinča Institute of Nuclear Sciences, Serbia,* ³*Institute of Technical Sciences of SASA, Belgrade, Serbia*

16.00 – 16.15 Application of microwave curing on in-situ cement and concrete manufacture

Yasemin Akyol, Sezen Donmez, Kosar Hassannezhad, Mehmet Ali Gulgun

Department of Material Sciences and Nano-Engineering, Faculty of Engineering and Natural Sciences, Sabanci University, Istanbul, Turkey 34956

16.15 – 16.30 Rheology and compatibility study of partly cured binders for plastic explosives

Ivan D. Dimitrijević, Danica M. Simić, Bojana Z. Fidanovski, Saša J. Brzić

Military Technical Institute, Belgrade, RS

16.30 – 16.45 Low temperature micromechanical properties of polystyrene

Hanna V. Rusakova, L.S. Fomenko, S.V. Lubenets

*B. Verkin Institute for Low Temperature Physics and Engineering of NAS of Ukraine,
Kharkiv, Ukraine, UA*

16.45 – 17.00 Break

17.00 – 18.15 8th Session – Materials for High-technology Application II Chairpersons: Dr. Lidija Mančić and Kristina Božinović

17.00 – 17.15 The influence of CrAlN coating chemical composition on detachment forces during HPDC

Dragan Kukuruzović¹, Lazar Kovačević¹, Pal Terek¹, Branko Škorić¹, Aleksandar Miletić¹, Peter Panjan², Miha Čekada²

¹*University of Novi Sad, Faculty of Technical Sciences, Novi Sad, Serbia,* ²*Jozef Stefan Institute, Ljubljana, Slovenia*

17.15 – 17.30 Investigation of structural and thermal properties of the Sn-Bi alloys

Kristina Božinović, Miljan Marković, Milana Milanović, Zoran Mladenović, Bojan Zdravković, Saša Đorđević, Nenad Jankucić

Technical Faculty in Bor, Department of Metallurgical Engineering, University of Belgrade, Vojske Jugoslavije 12, 19210 Bor, Serbia

17.30 – 17.45 Determination of fraction of scattered X-radiation on the radiotherapy device ELEKTA using (γ ,n) nuclear reactions

Anđela Mitrović, Marko Daković

University of Belgrade, Faculty of Physical Chemistry, Belgrade, Serbia

17.45 – 18.00 Surface characterization of wear resistant calender composite coatings

Miklós Jakab¹, Balázs Jakab²

¹*University of Pannonia, Institute of Materials Engineering, Veszprem, Hungary,* ²*AC2T research GmbH, Wiener Neustadt, Austria*

18.00 – 18.15 Characterization of Yb:YAG laser welding AZ61 magnesium alloys

Seddik Ouallam^{1,2,3}, J.-E. Masse², L. Barrallier², M. L. Djeghlal³, F. Peyre⁴, F. Guittonneau², L. Kaba¹, Z. Boutaghou¹

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Friday, December 7, 2018

09.00 – 10.45 9th Session – Nanostructured Materials I

Chairpersons: Dr. Dragana Jugović and Mila Krstajić Pajić

09.00 – 09.15 The ensemble effect in PtAu nanocatalysts

Mila N. Krstajić Pajić¹, Sanja I. Stevanović², Vuk V. Radmilović³, Velimir R. Radmilović^{1,4}, Snežana Lj. Gojković¹, Vladislava M. Jovanović²

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²University of Belgrade, Institute for Chemistry, Technology and Metallurgy, Department of Electrochemistry, Belgrade, Serbia, ³Innovation Center of the Faculty of Technology and Metallurgy, Belgrade, Serbia, ⁴Serbian Academy of Sciences and Arts

09.15 – 09.30 The consolidation process and microstructure analysis of synthesized diamonds within fractal nature analysis

Sandra Veljković¹, Vojislav V. Mitic^{1,2}, Goran Lazović³, Vesna Paunović¹, Markus Mohr⁴, Hans Fecht⁴

¹University of Niš, Faculty of Electronic Engineering, Niš, Serbia, ²Institute of Technical

Sciences of SASA, Belgrade, Serbia, ³University of Belgrade, Faculty of Mechanical Engineering, Belgrade, Serbia, ⁴Institute of Functional Nanosystems FNS, Ulm University, Germany

09.30 – 09.45 Enhanced electrocatalytic activity for methanol oxidation of polycrystalline platinum modified by iridium

Thomas S.A. Wakelin¹, Milutin Lj. Smiljanić², Zlatko Lj. Rakočević², Svetlana B. Štrbac¹

¹ICTM-Institute of Electrochemistry, University of Belgrade, Serbia

²INS Vinča, Laboratory of Atomic Physics, University of Belgrade, Serbia

09.45 – 10.00 Electrospun hybrids of carbon nanofibers with mixed metal oxide nanoparticles as high-performance battery-type supercapacitors

Daniel M. Mijailović¹, Uroš Č. Lačnjevac², Vuk V. Radmilović¹, Dušica B. Stojanović³, Velimir R. Radmilović^{3,4}, Vladimir D. Jović², Petar S. Uskoković³

¹University of Belgrade, Innovation Center, Faculty of Technology and Metallurgy,

Karnegijeva 4, 11120, Belgrade, Serbia, ²University of Belgrade, Institute for Multidisciplinary Research, Kneza Višeslava 1, 11030 Belgrade, Serbia, ³University of Belgrade, Faculty of Technology and Metallurgy, Karnegijeva 4, 11120, Belgrade, Serbia,

⁴Serbian Academy of Sciences and Arts, Knez Mihailova 35, 11000 Belgrade, Serbia

10.00 – 10.15 Influence of ultrasound on morphology and anticorrosive properties of electrodeposited Zn-Co-CeO₂ nanocomposite coatings

Marija Ridošić¹, Eva Garcia Lecina², Asier Salicio Paz², Ljiljana Živković³, Jelena Bajat⁴

¹University of East Sarajevo, Faculty of Technology, Zvornik, Bosnia and Herzegovina,

²CIDETEC Surface Engineering, San Sebastian, Spain, ³University of Belgrade, The Vinča

Istitute for Nuclear Sciences, Belgrade, Serbia, ⁴University of Belgrade, Faculty of Technology and Metallurgy, Belgrade, Serbia

10.15 – 10.30 Nano/microcontainers for corrosion protection of a copper/gold galvanic couple

Diogo E Almeida S¹, Isabel C S C Sousa¹, Fátima G C Montemor², Mário G S Ferreira¹
¹*Department of Materials Engineering and Ceramics/CICECO, University of Aveiro, Portugal,* ²*Instituto Superior Técnico, University of Lisbon, Portugal*

10.30 – 10.45 Phase composition of technologically-modified MgAl₂O₄ nanoceramics

Halyna Klym, Yuriy Kostiy, Ivanna Vasylychshyn
Lviv Polytechnic National University, 12 Bandera str., Lviv, 79013, Ukraine

10.45 – 11.00 Break

11.00 – 12.30 10th Session – Nanostructured Materials II

Chairpersons: Prof. Dr. Ivana Stojković Simatović and Maria Uzelac

11.00 – 11.15 Effects of electron acceptors and radical scavengers on the kinetics of photodegradation of ceftriaxone under simulated solar irradiation

Biljana F. Abramović, Maria M. Uzelac
University of Novi Sad, Faculty of Sciences, Department of Chemistry, Biochemistry and Environmental Protection, Trg D. Obradovića 3, 21000 Novi Sad, Serbia

11.15 – 11.30 Structural, morphological and optical characteristics of ZnO particles synthesized in the presence of surfactants CTAB and Pluronic F-127

Sanita Ahmetović¹, Stevan Stojadinović², Vladislav Rac³, Srečo Škapin⁴, Ivana Stojković Simatović¹, Smilja Marković⁵
¹*Faculty of Physical Chemistry, University of Belgrade, Studentski Trg 12, Belgrade, Serbia,* ²*University of Belgrade, Faculty of Physics, Belgrade, Serbia, University of Belgrade,* ³*Faculty of Agriculture, Belgrade, Serbia,* ⁴*Jožef Stefan Institute, Ljubljana, Slovenia,* ⁵*Institute of Technical Sciences of SASA, Knez Mihailova 35/IV, 11000 Belgrade, Serbia*

11.30 – 11.45 TiO₂/Ag nanoparticles modified cotton fabric and its application to photocatalysis

Milica V. Milošević, Marija B. Radoičić, Zoran V. Šaponjić
Vinča Institute of Nuclear Sciences, University of Belgrade, Belgrade, Serbia

11.45 – 12.00 Surface optical phonon – Plasmon interaction in nanodimensional CdTe thin films

Jelena Mitrić¹, N. Paunović¹, M. Mitrić², B. Vasić¹, U. Ralević¹, J. Trajčić¹, M. Romčević¹, W. D. Dobrowolski³, I. S. Yahia⁴, N. Romčević¹

¹University of Belgrade, Institute of Physics Belgrade, Belgrade, RS, ²University of Belgrade, Institute Vinča, Belgrade, RS, ³Polish Academy of Science, Institute of Physics, Warsaw, PL, ⁴King Khalid University, Faculty of Science, Department of Physics, Abha, SA

12.00 – 12.15 *In vitro* testing of genotoxic and apoptotic potential of two synthesized nanomaterials by DNA fragmentation assay

Sanja Stojanović^{1,2}, Lazar Bajić², Vladimir Cvetković³, Nenad Ignjatović⁴, Stevo Najman^{1,2}
¹University of Niš, Faculty of Medicine, Department of Biology and Human Genetics, 18000 Niš, Serbia, ²University of Niš, Faculty of Medicine, Scientific Research Center for Biomedicine, Department for Cell and Tissue Engineering, 18000 Niš, Serbia, ³University of Niš, Faculty of Sciences and Mathematics, Department of Biology and Ecology, 18000 Niš, Serbia, ⁴Institute of Technical Sciences of the Serbian Academy of Science and Arts, 11000 Belgrade, Serbia

12.15 – 12.30 Raman Spectroscopy Study on phase transition in CrI₃ single crystals

Sanja Đurđić¹, Andrijana Šolajić¹, Jelena Pešić¹, Maja Šćepanović¹, Y. Liu², Andreas Baum^{3,4}, Čeda Petrović², Nenad Lazarević¹, Zoran V. Popović^{1,5}
¹Institute of Physics, Pregrevica 118, Belgrade, Serbia, ²Brookhaven National Laboratory, Upton, New York 11973-5000, USA, ³Walther Meissner Institut, Bayerische Akademie der Wissenschaften, 85748 Garching, Germany, ⁴Fakultät für Physik E23, Technische Universität München, 85748 Garching, Germany, ⁵Serbian Academy of Sciences and Arts, Knez Mihailova 35, 11000 Belgrade, Serbia

12.30 – 13.45 Lunch break

13.45 – 15.15 11th Session – Nanostructured Materials III

Chairpersons: Dr. Smilja Marković and Dr. Maria Čebela

13.45 – 14.00 Influence of Ho doping on magnetic properties of bismuth ferrite nanopowders

Maria Čebela^{1,2}, Pavla Šenjug¹, Filip Torić¹, Željko Skoko¹, Teodoro Klaser¹, Damir Pajić¹
¹Department of Physics, Faculty of Science, University of Zagreb, Bijenička c. 32, HR-10000 Zagreb, Croatia, ²Institute for Nuclear sciences, Centre of Excellence-CextremeLab "Vinča", University of Belgrade, 11000 Belgrade, Serbia

14.00 – 14.15 Microstructural changes of (Ti_{1-x}M_x)C (M=Cr and W) solid solutions induced by mechanical alloying

Mohsen Mhadhbi¹, Houyem Abderrazak¹, Mohamed Khitouni²
¹Laboratory of Useful Materials, National Institute of Research and Physical-chemical Analysis, Technopol of Sidi Thabet, 2020 Sidi Thabet, Tunisia, ²Laboratory of Inorganic Chemistry, 99/UR/12-22, Sciences Faculty of Sfax, Sfax 3018, Tunisia

14.15 – 14.30 Macro and micro wettability of hydrophobic rough surface

Konrad Terpiłowski¹, Olena Goncharuk², Salvador Pérez – Huertas¹, Maciej Nastaj³

¹*Department of Physical Chemistry-Interfacial Phenomena, Faculty of Chemistry, Maria Curie-Skłodowska University, sq. Maria Curie-Skłodowska 3, 20-031 Lublin, Poland,*
²*O.O.Chuiko Institute of Surface Chemistry, National Academy of Sciences of Ukraine, st. Generala Naumova 17, 03164 Kyiv, Ukraine,* ³*Department of Milk Technology and Hydrocolloids, University of Life Sciences in Lublin, st. Skromna 8, 20-704 Lublin, Poland*

14.30 – 14.45 Spectrophotometric and thermal properties of poly(vinyl butyral) and epoxy protective coatings with nanostructures of WS₂

Danica Simić, Aleksandra Samolov, Bojana Fidanovski, Ljubica Totovski
Military Technical Institute, Ratka Resanovića 1, 11030 Belgrade, Serbia

14.45 – 15.00 Unstable plastic deformation of ultrafine-grained magnesium alloy AZ31 at low temperature

Pavel A. Zabrodin

B. Verkin Institute for Low Temperature Physics and Engineering of NAS of Ukraine, 47 Nauky Ave., Kharkiv, 61103, Ukraine

15.00 – 15.15 Optical detection of ultra-trace level of aqueous uranyl ions by magnetically functionalized cadmium sulphide quantum dots fluoroprobe

Ambika Kumar¹, Deepika Dimri²

¹*Department of Chemistry, Bhagalpur National College Bhagalpur, India,* ²*School of Environment & Natural Resources, Doon University Dehradun, India*

15.15 – 15.30 Break

15.30 – 17.00 12th Session – Environmental Materials I

Chairpersons: Dr. Jasmina Dostanić and Pozhhan Mokhtari

15.30 – 15.45 Customizing nanotubular titania for photocatalytic activity

Jelena Vujančević¹, Anđelika Bjelajac², Jovana Ćirković³, Vera P. Pavlović⁴, Endre Horváth⁵, László Forró⁵, Đorđe Janačković⁶, Vladimir B. Pavlović¹

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²*University of Belgrade, Innovation Center of Faculty of the Technology and Metallurgy, Karnegijeva 4, 11000 Belgrade, Serbia,* ³*University of Belgrade, Institute for Multidisciplinary Research, Kneza Višeslava 1, 11000 Belgrade, Serbia,* ⁴*University of Belgrade, Faculty of Mechanical Engineering, Kraljice Marije 16, 11000 Belgrade, Serbia,*
⁵*Ecole Polytechnique Fédérale de Lausanne, Laboratory of Physics of Complex Matter (LPMC), CH-1015 Lausanne, Switzerland,* ⁶*University of Belgrade, Faculty of Technology and Metallurgy, Karnegijeva 4, 11000 Belgrade, Serbia*

15.45 – 16.00 Synthesis and characterisation of ZnO synthesized by glycine-nitrate combustion process

Milena P. Dojčinović¹, Smilja Marković², S. Stojadinović³, V. Rac⁴, Ivona Janković-Častvan⁵, Ivana Stojković Simatović⁶

¹*Institute for Multidisciplinary research, Univecity of Belgrade, Serbia,* ²*Institute of Technical Sciences of the Serbian Academy of Science and Arts, Belgrade, Serbia,* ³*University of Belgrade, Faculty of Physics, Belgrade, Serbia,* ⁴*University of Belgrade, Faculty of Agriculture, Belgrade, Serbia,* ⁵*University of Belgrade, Faculty of Technology and Metallurgy, Belgrade, Serbia,* ⁶*Faculty of Physical Chemistry, University of Belgrade, Serbia.*

16.00 – 16.15 Kinetics and modeling of sorption behavior of chitosan-based hydrogel

José Joaquim Bandeira Almeida Rodrigues de Oliveira, Pantaporn Sittplangkoon, Ksenija Milošević, Marija Lučić Škorić, Melina Kalagasidis Krušić

¹*Federal University of Sergipe, Department of Chemical Engineering, São Cristóvão, Brazil,*

²*Chulalongkorn University, Interdisciplinary Program in Environmental Science, Bangkok, Thailand,*

³*University of Belgrade, Faculty of Technology and Metallurgy, Belgrade, Serbia,*

⁴*University of Belgrade, Innovation Center of the Faculty of Technology and Metallurgy, Belgrade, Serbia*

16.15 – 16.30 The application of calcined clay materials from waste mine overburden as cement substitution

Pozhhan Mokhtari, Sorour Semsari Parapari, Noyan Ozkan, Mehmet Ali Gulgun

Department of Material Sciences and Nano-Engineering, Faculty of Engineering and Natural Sciences, Sabanci University, Istanbul, Turkey 34956

16.30 – 16.45 Electrochemical behaviour of carbon steel C15 in the presence of aloe vera gel

Milica Bošković, Vesna Grekulović, Mirjana Rajčić Vujasinović, Aleksandra Mitovski, Uroš Stamenković

University of Belgrade, Technical Faculty in Bor, Bor, Serbia

16.45 – 17.00 Sorption of Pb²⁺ ions from wastewater by Paulownia leaves and their hydrochar

Marija R. Koprivica, Jelena T. Petrović, Marija S. Petrović, Marija L. Mihajlović, Jelena V. Milojković, Marija M. Kojić, Mirjana D. Stojanović

Institute for Technology of Nuclear and Other Mineral Raw Materials, 86 Franchet d'Esperey St., 11000 Belgrade, Serbia

17.00 – 17.15 Break

17.15 – 18.30 13th Session – Environmental Materials II

Chairpersons: Dr. Veljko Đokić and Aleksandra Kulić Mandić

17.15 – 17.30 Adsorption study of cadmium ions on modified kaolinite by some amino acids

Nataša Mladenović¹, Marija Ivanović², Ljiljana Kljajević², Jelena Gulicovski², Snežana Nenadović², Katarina Trivunac¹

¹*Faculty of Technology and Metallurgy, University of Belgrade, Belgrade, Serbia,*

²*Laboratory for Materials Sciences, Vinča Institute of Nuclear Sciences, University of Belgrade, Belgrade, Serbia*

17.30 – 17.45 Optimization of biocomposite composition for efficient adsorption of nickel (II) ions

Durica Katnić¹, Milan Milivojević², Aleksandar Marinković², Mirjana Kostić², Jelena Georgijević¹, Milena Pijović¹

¹*Vinča Institute of Nuclear Sciences, University of Belgrade, Belgrade, Serbia,* ²*Faculty of Technology and Metallurgy, University of Belgrade, Belgrade, Serbia*

17.45 – 18.00 Assessment of the applicability of raw and calcined seashells for the treatment of industrial wastewater

Marija S. Egerić, Ivana D. Smičiklas, Mihajlo D. Jović, Marija Z. Šljivić-Ivanović
University of Belgrade, Vinča Institute of Nuclear Sciences, P.O. Box 522, 11000 Belgrade, Serbia

18.00 – 18.15 Iron-impregnated paper mill sludge as Fenton process catalyst

Aleksandra Kulić Mandić, Milena Bečelić-Tomin, Đurđa Kerkez, Gordana Pucar Milidrag, Božo Dalmacija

University of Novi Sad, Faculty of Sciences, Department of Chemistry, Biochemistry and Environmental Protection, Trg Dositeja Obradovića 3, 21000 Novi Sad, Republic of Serbia

18.15 – 18.30 Influence of the type of polyacrylamide ionic group on the accumulation of chromium(VI) ions in the montmorillonite-aqueous solution system

Małgorzata Wiśniewska¹, Gracja Fijałkowska¹, Katarzyna Szewczuk-Karpisz²

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18.40 Closing Ceremony

1-1

Subcutaneous tissue reaction to collagen-based membranes of different origin

Milena Radenković¹, Sanja Stojanović^{1,2}, Jelena Živković^{1,2}, Vladimir Cvetković³,
Žarko Mitić⁴, Shahram Ghanaati⁵, Stevo Najman^{1,2}

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Collagen is widely used in the form of membranes or as a component of different biomaterials and scaffolds intended for use in hard and soft tissue engineering and regenerative medicine. Collagen-based membranes can be of different origin (equine, bovine or porcine), different architectures and porosity, and can be physically and/or chemically modified with different biologically active substances. The aim of our study was to examine and compare the subcutaneous tissue reaction to the implanted collagen membranes of different origin. We examined two different membranes: 4BONE RCM (porcine collagen resorbable membrane) and Parasorb Resodont® (equine collagen absorbable membrane) in subcutaneous implantation model into Balb/c mice. Tissue reaction to the membranes was analyzed 3, 10 and 30 days after implantation by hematoxylin&eosin and Azan trichrome staining of paraffin embedded tissue sections, while histomorphometrical analysis was performed for measurements of the changes in membrane thickness. The differences in the tissue reaction, infiltration of cells and the thickness between examined collagen membranes were noticed at all analyzed time points. Those differences were probably due to the different origin of collagen membranes and also could be the consequence of potentially different manufacturing process.

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1-2

Antibiotic loaded bioactive orthopedic implant coating

Milena Stevanović¹, Ana Janković¹, Marija Došić², Maja Vukašinić-Sekulić¹,
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A single-step electrophoretic deposition (EPD) process from aqueous suspension was used to assess novel composite coating of hydroxyapatite (HAP) with natural polymer chitosan (CS) and antibiotic, gentamicin (Gent). EPD was carried out at constant voltage on pure titanium plates. In order to investigate the gentamicin influence on physico-chemical and biological properties of composite coatings, detailed characterization was performed. For that purpose X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FT-IR), and field-emission scanning electron microscopy (FE-SEM) were used. Obtained results confirmed the formation of a new composite HAP/CS/Gent coating. Potential application was examined through biological assays. The gentamicin addition strongly improved the antibacterial activity of HAP/CS/Gent coating that was confirmed by agar diffusion method and test in suspension. Obtained results indicated more pronounced antibacterial effect against *Staphylococcus aureus* compared to *Escherichia coli*. MTT and DET tests indicated low cytotoxicity against MRC-5 and L929 tested cell lines, indicating good biocompatibility of obtained composites. MRC-5 human cell line responded better in cytotoxicity testing, pointing to encouraging results for potential application. The ability of biomineralization promotion was noticed through the ALP assay. Therefore, HAP/CS/Gent coating can be considered as perspective material for bone tissue engineering as hard tissue implant.

1-3

Production of composite hydrogels based on poly(vinyl alcohol) and β -tricalcium-phosphate for potential applications in bone tissue implants

Natalija Stojanović, Jasmina Stojkovska, Đorđe Veljović, Bojana Obradović
Faculty of Technology and Metallurgy, University of Belgrade, Belgrade, Serbia

β -tricalcium-phosphate (β -TCP), a hydroxyapatite precursor, is used in reconstruction of bone tissue due to similarities with bone inorganic components, biocompatibility and osteoinductive potentials. However, due to poor mechanical properties, β -TCP alone is not suitable for bone tissue implants but could be used in combination with polymer matrices. Poly(vinyl alcohol) (PVA) is a synthetic, water soluble polymer, commonly used in 3D printing that could be physically crosslinked by repeated freezing-thawing cycles. The aim of this study was to fabricate composite hydrogels, based on PVA with the highest possible fraction of β -TCP particles. Composition of the PVA and β -TCP mixture was optimized so that it could be extruded through a blunt-edge needle into a cooled gelling solution forming particles and microfibers that could be arranged in different shapes. Scanning electron microscopy has revealed uniform distribution of the inorganic phase in the hydrogel. Dried microfibers had a high fraction of β -TCP (71.4 mass.%). In conclusion, the obtained mixtures are attractive for potential applications in 3D printing of osteoinductive coatings or implant parts (fixators, plates, screws etc.).

1-4

Characterization of porous alginate hydrogels with bioactive hydroxyapatite precursor particles for bone tissue engineering

Jovana Skenderija, Nataša Tomašević, Jasmina Stojkovska,
Đorđe Veljović, Bojana Obradović,
Faculty of Technology and Metallurgy, University of Belgrade, Belgrade, Serbia

Highly porous composite alginate with embedded β -tricalcium-phosphate (β -TCP) particles was produced in previous studies with the aim to imitate the natural bone structure. Addition of β -TCP a hydroxyapatite (HAp) precursor provides osteoconductivity, improves mechanical properties, and finally should lead to production of the bone mineral phase. The aim of this work was characterization of the composite alginate hydrogels regarding mechanical properties and HAp formation in the simulated body fluid. Two composite samples with different alginate and β -TCP concentrations (1 and 2 mass. % of each component) were produced and characterized regarding mechanical properties in a bioreactor with dynamic compression at 10 % strain and 337.5 $\mu\text{m/s}$ compression rate. HAp formation was studied under static conditions in Petri dishes over 14 days. After this period, the samples were characterized regarding porosity, mechanical stability and Ca/P atomic ratio by EDS analysis. The samples retained their integrity while scanning electron microscopy showed presence of HAp. The obtained results indicated possibilities for use of the composite hydrogels in bone tissue engineering.

1-5

**Development and optimization of the production procedure
of biphasic scaffolds for osteochondral tissue engineering**

Mia Radonjić, Jovana Zvicer, Bojana Obradović
*University of Belgrade, Faculty of Technology and Metallurgy,
Chemical Engineering, Belgrade, Serbia*

Scaffolds used for osteochondral tissue engineering should comprise two distinct regions: a bottom region with characteristics corresponding to bone tissue, such as a porous structure with mineral components (predominantly hydroxyapatite), and a top region with characteristics of articular cartilage, which is gelatinous with high water content. In this work, we have investigated possibilities to formulate and optimize a procedure for obtaining such biphasic scaffolds based on gellan gum (GG). A porous base layer of the scaffold was obtained by lyophilization of the 2 % GG hydrogel with dispersed bioactive glass nanoparticles, as hydroxyapatite precursors. Next, different procedures were investigated to produce the upper GG hydrogel such as partial immersion of the porous layer in the GG solution and pouring the GG solution over the porous layer at different moisture conditions and temperatures. A simple mathematical model was derived and subsequently experimentally validated to find optimal temperatures of the porous layer, GG solution and the surrounding environment to provide adequate gelation rate to form the GG hydrogel on top of the porous layer with a thin interfacial zone.

1-6

**Functional characterization of biphasic implants based on gellan gum
and bioactive glass for osteochondral tissue engineering**

Ilijana Kovrlija, Jovana Zvicer, Bojana Obradović
*University of Belgrade, Faculty of Technology and Metallurgy,
Department of Chemical Engineering, Belgrade, RS*

Osteochondral implants need to be compatible with bone tissue in their base, and with cartilage tissue in the surface layer with an integrated interfacial zone. In this work, we have used a previously optimized procedure to produce biphasic scaffolds based on gellan gum (GG) and bioactive glass (BAG). In specific, the upper scaffold layer consisted of the 2 mass. % GG hydrogel corresponding to cartilage while the bottom layer was lyophilized GG hydrogel with 2 mass. % of BAG corresponding to bone. The obtained scaffolds were characterized under physiologically relevant conditions in a biomimetic bioreactor during 14 days at the constant flowrate of the simulated body fluid of 1.1 mL/min. Dynamic compression (337.5 $\mu\text{m/s}$ compression rate, 5 % deformation of the upper layer, 1 h/day) was applied from day 7 until day 14. Over the examined period, the scaffolds retained their mechanical integrity while SEM and EDX analyses have shown transformation of BAG into hydroxyapatite, good integration of the two layers and preserved porosity of the bottom layer, indicating potentials for osteochondral tissue engineering.

1-7

Processing of dental inserts based on nanostructured magnesium doped calcium-hydroxyapatite and their application as dental substitutes

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The utilization of bioceramic dental inserts as restoratives may improve mechanical properties and reduce polymerization shrinkage. Moreover, the application of inserts for restoration of large cavities in the clinical protocol may simplify the procedure. Bioactive materials may induce remineralisation of teeth and therefore prevent occurrence of secondary caries. The aim of this study was to investigate possibility of processing of bioactive dental inserts based on Mg doped hydroxyapatite (Mg-HAp) and their potential application as dental substitutes by determining shear bond strength (SBS) of inserts with different restorative materials. Nanostructured Mg-HAp powder was synthesized hydrothermally and pressed into cylindrical inserts. Bioactivity of inserts was monitored by scanning electron microscopy (SEM) after aging in simulated body fluid (SBF). After 28 days high bioactivity was detected. Maximum SBS value was obtained with Single Bond Universal adhesive by applying "total-etch" protocol and exceeded previously reported values. Acidic pre-treatment of inserts' surface was shown to be of great importance.

1-8

Temperature changes during light curing of conventional and “bulk-fill” dental composites

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The aim of this study was to measure the temperature of conventional and “bulk-fill” dental composites during light curing.

Uncured conventional flowable (Filtek Flow Ultimate, 3M ESPE), conventional sculptable (Filtek Ultimate, 3M ESPE), “bulk-fill” flowable (Tetric EvoFlow Bulk Fill, Ivoclar Vivadent and “bulk-fill” sculptable (Tetric EvoCeram Bulk Fill, Ivoclar Vivadent) composites were applied in molds 6 mm in diameter and 2 or 4 mm deep depending on type of composite (n=3). Composite materials were cured using a high intensity LED light-curing unit (Polywave Bluephase, Ivoclar Vivadent, Germany), operating at an intensity of 1200 mW/cm² for 10 s. Subsequent light curing of already cured composite was performed for 10 s. A K-type thermocouple was fixed at the bottom side of each sample. Real-time temperature measurements were performed using a “data-logger” (Measurement Computing) at 1 s/scan.

After the initial curing, the highest temperature was recorded for conventional flowable composite. Generally, higher temperatures were noted for flowable (conventional 50,12±3,26 °C; “bulk-fill” 47,10±1,59 °C) than sculptable composites (conventional 42,57±2,05 °C; „bulk-fill“ 44,18±2,53 °C). After subsequent light curing, lower temperatures were recorded compared to initial curing in all groups. The lowest temperature was observed for Tetric EvoCeram Bulk (37,82±1,9 °C).

Light curing heated the composite to temperatures which overcome the threshold (42,5 °C) that can cause irreversible damage to the dental pulp. Light curing flowable composites generated more heat than sculptable composites because of higher fraction of organic matrix and exothermic polymerization reaction. Although applied in a larger volume, the temperature of “bulk-fill” composites was similar to that of conventional composites.

Keywords: conventional composites, “bulk-fill” composites, flow composites, sculptable composites, temperature, polymerization

2-1

Biodegradable microparticles as a scaffolds for cell therapy

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Cell therapy is promising strategy that has attracted a lot of attention recently regarding regeneration of diverse tissues and treatment of various pathological conditions. Despite its great potential, several issues still need to be addressed. Among them administration route and dose, microenvironment conditions and host immune response are recognized as a major causes which lead to cells transplantation failure. In this work it is presented novel microstructural system based on biodegradable polymer poly(lactide-co-glycolide) (PLGA) and combination of biocompatible polyvinyl alcohol (PVA) and chitosan, as a scaffold for human mesenchymal stem cells (hMSCs) growth. The obtained microparticles with diameter 200-600 μm showed full biocompatibility with human hMSCs. Besides serving as a solid support, polymeric particles provided controlled release of contrast agent - gadolinium fluoride nanoparticles (Gd-NP) up to 5 weeks. The release of Gd-NP is enhanced by acidic conditions. Magnetic Resonance Imaging (MRI) of the samples embedded in 1% agar showed that contrast enhancement in T1-weighted (T1w) MR images is influenced by the amount of released Gd-NP. Based on these preliminary results, presented theranostic system could be considered for cells grafting.

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2-2

Structural analysis of antiradical activities of catecholamines

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The importance of molecules with antiradical activity that are produced in the human body has significantly increased. Among others, neurotransmitters and their metabolites act as the first line of defense against oxidative stress in the peripheral endocrine and the central nervous systems. Antiradical activity of catecholamines (dopamine, epinephrine, norepinephrine, L-DOPA, catechol) and metabolites of dopamine (3-methoxytyramine (3-MT), homovanillic acid (HVA), 3,4-dihydrophenylacetic acid (DOPAC), and vanillylmandelic acid (VMA)) was investigated toward 2,2-diphenyl-1-picrylhydrazyl (DPPH) and 2,2'-azino-bis(3-ethylbenzothiazoline-6-sulphonic acid) (ABTS) radicals using UV-VIS and electron spin resonance (ESR) methods. Except for 3-MT, homovanillic acid and vanillylmandelic acid, other investigated molecules show good scavenger radical activity. It was found that antiradical activity of catecholamines is strongly dependent on the structure and position of the side-chain substituents in the ring.

2-3

Synthesis and controlled drug release of poly(N-isopropylacrylamide) based thermosensitive hydrogels and encapsulation with paracetamol

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Reduced side-effects, reduced doses, predictable release rates and improved stability of the encapsulated drug are one of many benefits of controlled drug release. That is the reason behind increased development of different drug release systems.

In this study, poly(N-isopropylacrylamide) based negatively thermosensitive hydrogels were synthesized: IPN PNIPA, PNIPA and PNIPAcOBMA. These hydrogels were encapsulated with a fever reducing drug, paracetamol. The potential use of encapsulated hydrogels as a controlled drug release system was studied. In this case, there are no side effects due to the rapid release of the drug with a higher concentration than necessary, as opposed to using a tablet of paracetamol.

With the rise of body temperature, paracetamol releases continually. Controlled release of paracetamol was observed between body, and elevated body temperature, in the range between 36 and 42 degrees. The release was observed 5, 10, 15, 20, 30 minutes, 1h, 2h, 3h after exposure of incapsulated hydrogels to different temperatures. By HPLC analysis of these samples a linear dependence of loaded drug concentration with time, in the first time period, was proven. The results show that PNIPA and PNIPAcOBMA hydrogels are not thermosensitive enough in the desired temperature range, but that IPN PNIPA hydrogels can be used for the described intention.

2-4

Synthesis and characterization of genipin-crosslinked chitosan hydrogels

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Chitosan-based hydrogels were synthesized by crosslinking with genipin. Genipin, a naturally derived agent, was selected because of the lower cytotoxicity compared to many other commonly used synthetic crosslinking reagents. Swelling properties of these hydrogels were studied in solutions of different pH's. Fourier transform infrared spectroscopy was used to determine the functional groups present in the gel constituents together with understanding as to how the spectra change upon swelling or shrinking. Thermal characteristics were examined using differential scanning calorimetry. The results were used to evaluate the possibility for applications of genipin-crosslinked chitosan hydrogels in tissue engineering and drug delivery.

2-5

**Production optimization of nanocomposite microfibre hydrogels
based on alginate, honey and silver nanoparticles**

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Alginate hydrogels exhibit widespread use as wound dressings, where their functionality can be improved by addition of different therapeutic agents such as silver nanoparticles, for their antimicrobial effect, and honey, for its wound recovery stimulation. The goal of this research was the optimization of the production of nanocomposite alginate microfibers with immobilized silver nanoparticles and honey components for the potential use in wound treatment. In previous studies, nanocomposite hydrogels with 50 wt. % honey were produced. The concentration of total sugars was quantified (564 mg/ml) and found to be lower than sufficient to exhibit the desired beneficial effects. In this study the possibility of mixing alginate solution with honey at higher concentrations (60-90 wt. %) was explored with the aim to obtain microfibers with the maximal honey concentration by extrusion into a gelling solution. Nanocomposite microfibers were then produced from the obtained colloid mixture and analyzed by UV-visible spectroscopy and the phenol-sulfuric acid method in order to determine the total sugars preserved.

2-6

Silver/poly(vinyl alcohol)/chitosan and silver/poly(vinyl alcohol)/chitosan/graphene hydrogels – electrochemical synthesis, silver release and antibacterial properties

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The new-generation antibacterial wound dressings with improved properties have to conform to several important requirements, such as the ability to absorb wound exudates, to possess good mechanical properties and low adhesiveness, in order to prevent sticking to the wound and to avoid the danger of further wound tissue damage. The polymer-based hydrogels with high water content and good swelling properties are especially attractive materials for such purpose. In this work, we prepared silver/poly(vinyl alcohol)/chitosan (Ag/PVA/CHI) and silver/poly(vinyl alcohol)/chitosan/graphene (Ag/PVA/CHI/Gr) hydrogels intended for wound dressing applications. Poly(vinyl alcohol), a synthetic biocompatible polymer with high elastic modulus served as main matrix for the preparation of hydrogels, whereas chitosan was added because of its intrinsic antibacterial activity and ability to promote healing. Graphene was also included as nano-filler to improve mechanical properties and tensile strength of hydrogel material. Silver nanoparticles (AgNPs) as antibacterial agent were prepared *in situ* in the hydrogel matrix by electrochemical reduction method and their successful incorporation was validated by UV-visible spectroscopy. The time-dependent release of AgNPs was monitored over 28 days in physiologically-relevant phosphate buffer (PB), and the content of released silver was determined using atomic absorption spectroscopy (AAS). Sorption and swelling properties of the obtained hydrogels were also investigated in PB. The effect of graphene as well as chitosan content on silver release and swelling ability of the hydrogels was assessed. The antibacterial properties against *Staphylococcus aureus* and *Escherichia coli* bacteria were confirmed using the disc-diffusion and suspension methods, and non-toxicity of the obtained hydrogels towards MRC-5 fibroblast cell line was confirmed using MTT test. The obtained results indicated that the nanocomposite Ag/PVA/CHI and Ag/PVA/CHI/Gr hydrogels exhibited good antibacterial properties and no cytotoxic effect, making them good candidates for potential use as next-generation wound dressing materials.

2-7

Chitosan-g-oligolactide copolymers for regenerative medicine

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Combination of synthetic and natural polymers within one macromolecule allows to extend a range of processing techniques for fabrication of materials as well as to adjust their properties. Among a variety of methods to synthesize such copolymers mechanochemical approach is particularly attractive due to its ability to overcome problems arising from natural polymers unmelting and incompatibility with synthetic polymers. Another advantage of solid-state mechanochemical synthesis is an absence of any solvents and catalysts, which is especially important for further application of reaction products for biomedical application. This work was aimed to synthesize graft-copolymers of chitosan (derivative of natural polysaccharide chitin) and oligolactides (synthetic polyester) using solid-state reactive blending approach and to evaluate a processability of such copolymers using a variety of methods into 3D materials tailored for regenerative medicine. Effectiveness of solid-state synthesis as a function of initial components characteristics (molecular weight, stereochemical composition) and additional presence of collagen into reaction mixtures was evaluated. Grafting of hydrophobic oligolactides onto hydrophilic chitosan led to amphiphilic properties of the copolymers, which allowed using them as emulsifier for fabrication of cell microcarriers and to control properties of based on hydrogels. The cross-linking of hydrogels was carried out using thermal or photo-induced techniques. Effect of copolymers characteristics on cross-linking degree and properties of the obtained materials was evaluated as well.

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2-8

**Characteristic of titanium dioxide - chitosan - hyaluronic acid systems
interactions with DPPG membrane**

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Chitosan, titanium dioxide and hyaluronic acid are the substances that naturally occur in nature. Due to their interesting physico-chemical properties like biocompatibility, biodegradability, non-toxicity and antibacterial properties, have become a fascinating subject of research for scientists from different fields of science. One of the proposed mechanisms of antibacterial action of chitosan and/or TiO_2 is based on disturbances of biological membranes of bacteria. Therefore, apart from the evaluation of antibacterial properties strictly for microorganisms (studies that involve disturbances in the cell's life cycle), it is important to check the effect of these substances on the biomembranes. Most often these tests are performed using DPPG (dipalmitoylphosphatidylglycerole) because it is typical component of bacterial membranes (content up to 20%).

Study of the influence of individual components on the biological membranes of prokaryotes is possible thanks to Langmuir's trough. This technique involve recording the compression isotherms of lipid films in which we obtain the dependence of surface pressure as a function of the surface per lipid molecule in the whole monolayer - characteristic for individual phospholipids.

The aim of the study was test the influence of Chitosan-Titanium Dioxide-Hyaluronic Acid systems on the bacterial membrane. This goal was achieved by examining the changes on the DPPG isotherm. Our examination and obtained results may be helpful in understanding the mechanism of action of these substances, each of the components individually, as well as all simultaneously in the mixture.

3-1

**The investigation of structural and morphological properties
of starch coated Ni-Zn-ferrites**

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Zinc-ferrite, nickel-ferrite and mixed nickel-zinc ferrites were synthesized *via* the thermal decomposition method from the precursor complexes containing acetylacetonate as ligand. The biomedical application of ferrites requires controllable particle size and enhanced dispersibility in a physiological medium. Surface coating of the samples obtained from acetylacetonate complexes was achieved using starch, a natural and biocompatible compound, for the first time. Investigation of their structural and microstructural properties by X-ray powder diffraction (XRPD) was performed. The XRPD results confirmed the crystalline nature and presence of single phase spinel structure. The unit cell parameter decreased, while the crystallite size increased with decreasing zinc content in the structure. The average microstrain parameters unambiguously showed a change in the spinel structure with cation distribution. Scanning electron microscopy (SEM), energy-dispersive X-ray spectroscopy (EDS) and Fourier transform infrared spectroscopy (FTIR) analyses were also performed to characterize the synthesized magnetic powders. The obtained results indicated that functionalization by starch was successfully achieved.

3-2

Novel pH sensitive degradable zwitterionic hydrogels based on poly(β -amino esters)

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Hydrogels with stimuli-responsive properties have been explored extensively in the previous decade, due to their various actual and potential biomedical applications. In this study, novel pH-sensitive degradable zwitterionic hydrogels, based on poly(β -amino esters) (PBAE) macromers, were developed. PBAE macromers were prepared by Michael addition reaction of the α -amino acid glycine and diethylene glycol diacrylate. PBAE based hydrogels were synthesized using PBAE macromers of different molecular weight, by free radical polymerization. The structure of the PBAE macromers and hydrogels was confirmed using nuclear magnetic resonance (NMR) and Fourier transform infrared spectroscopy (FTIR). Swelling studies, conducted in the physiological pH range from 2.20 to 8.00 showed the pH sensitivity of the hydrogels. Hydrogel degradation was characterized by the weight loss ratio under physiological conditions. Cytotoxicity, embryotoxicity and teratogenicity assays were performed to assess the biocompatibility of the novel hydrogel materials and their degradation products. The obtained results show that the properties of the acquired samples can easily be tuned by varying the amine/diacrylate ratio, thus changing the molecular weight/chain length of the synthesized PBAE macromers. The current studies suggest that the synthesized hydrogels exhibit great potential for a variety of biomedical applications, including intelligent drug delivery systems and tissue regeneration.

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3-3

**Smart biocompatible and biodegradable hydrogel matrices
based on natural and synthetic polymers**

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Hydrogels have been used in a wide variety of biomedical applications. Hydrogels show excellent biocompatibility, probably due to their structural similarity to the macromolecular-based components in the body. Its high, tissue-like water content and porous structure allows the influx of low molecular weight solutes and nutrients crucial to cellular viability, as well as the transport of cellular waste out of the hydrogel. This study features the design of novel smart, biocompatible and biodegradable hydrogels based on gelatin, alginate and hydroxyethyl (meth)acrylates using porogenation and cryopolymerization techniques. Chemical composition, morphology, swelling capacity and degradation rate of the synthesized hydrogels were evaluated by Fourier transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM), swelling and weight loss measurements. As an initial step for evaluation of performance of the hydrogels in the biological environment, the *in vitro* biocompatibility of these hydrogels, was evaluated using LDH activity. Obtained results showed that the hydrogels possess a porous morphology with interconnected pores, *in vitro* degradation after 3 months, and satisfied biocompatibility. These unique performances of obtained hydrogels make them promising candidates for a variety of biomedical uses.

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3-4

**Fibroblasts' proliferation on collagen-based membranes
of different origin – *in vitro* study**

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Collagen-based biomaterials are widely used in various fields of dentistry, oral and maxillofacial surgery, when the growth of new bone is needed. The primary task of collagen membranes is to stop the in-growth of the connective tissue into the defect thus ensuring an undisturbed formation of the new bone tissue. There are many types of collagen membranes regarding the composition and they can be of different origin: porcine, equine or bovine. Resorbable collagen membranes should have an ability to promote platelet aggregation and attract fibroblasts, which facilitates wound healing. Our aim was to analyze *in vitro* biocompatibility of two collagen membranes of different origin. L929 fibroblasts were directly cultured on 4BONE RCM (porcine collagen resorbable membrane) and Parasorb Resodont® (equine collagen absorbable membrane) membranes for seven days in standard cell culture conditions. Cell proliferation was then measured by MTT test. The results showed significant difference in the proliferation rates between cells cultured on these two membranes. The difference in proliferation of fibroblasts on membranes could be due to the different origin of collagen membranes, but also due to the manufacturing process that may affect the cell growth and both aspects should be considered.

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3-5

Studies on properties of lipid-peptide films on a polymer support

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Both natural and synthetic polymers due to their structure and useful properties are very common all over the world. They are used in many fields of life. From the economical point of view synthetic polymers are more desirable. One of the polymers with the unusual properties and wide spectrum of application is a representative of polyesters – polyethylene terephthalate (PET). PET has great thermoplastic properties, high mechanical resistance and is nontoxic. That is why it is applied in food and pharmaceutical industry as well as medicine. PET is used as material to make implants. Therefore, the PET surface should be characterized by high compatibility with the organism.

In our study to improve PET biocompatibility its surface was modified by the low temperature plasma and/or deposition of biologically active substances, i.e. chitosan (Ch); 1,2-dipalmitoyl-*sn*-glycero-3-phosphocholine (DPPC); cholesterol (Chol); cyclosporine A (CsA). Ch was chosen due to its antibacterial properties, DPPC and Chol as main components of biological membranes, CsA as an immunosuppressive drug preventing from the transplant rejection. The films were deposited on the PET plates by means of the Langmuir-Blodgett or dip-coating techniques. Wettability of the surfaces was investigated by advancing and receding contact angle measurements and then surface free energy was determined from the theoretical models.

It is believed that these studies will be helpful in a rational development of implant surface with the increased biocompatibility.

3-6

Wetting properties of plasma activated and biocoated PEEK surfaces

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Polyetheretherketone (PEEK) is highly biocompatible polymer widely used in medicine as material for implant production [1]. The PEEK surface was characterized in terms of its wettability properties after physicochemical modifications by treatment with the low temperature air plasma and by covering with Langmuir-Blodgett (LB) monolayers of polypeptide (cyclosporine A, CsA) and/or phospholipid (1,2-dipalmitoyl-*sn*-glycero-3-phosphocholine, DPPC). Characteristic of interactions between the PEEK supported membrane and liquids used for wettability determination was based on the theoretical model of interfacial interactions proposed by van Oss et al. [2]. This kind of modifications can enhance polymer biocompatibility, increase cells adhesion, accelerate tissues healing or reduce inflammation. The preparation of films with defined polarity and various compositions is an important step in the development of polymer surfaces with increased biofunctionality.

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3-7

Synthesis and characterization of bioactive glass doped with lithium and strontium ions

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Bioactive glasses have been used for over three decades in biomedical applications owing to high bioactivity, biocompatibility, as well as the possibility to stimulate regeneration of the bone.

The aim of this work was to synthesized bioactive glasses, which contain lithium and strontium, by commercial method melting-quenching, as well as determining the properties, affected by mentioned ions. Differential thermal/thermogravimetric analysis, particle size distribution, energy-dispersive X-ray spectroscopy, inductively coupled plasma optical emission spectrometry, evaluation of the antimicrobial activity, *in vitro* bioactivity and biocompatibility test and scanning electron microscopy were used for characterization.

The results showed that glass transition and crystallization temperatures are decreasing with addition of lithium and strontium ions. Furthermore, the samples showed high inhibition rate of *Escherichia coli* growth, as well as high bioactivity and biocompatibility. The crystal apatite layer, formed on the surface of synthesized glasses after seven days in simulated body fluid, differs in shape, size and interconnection of the glass particles, which depends on concentration of lithium and strontium ions.

3-8

Phase, morphological and statistical analysis of urinary stones from Serbian patients

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In this paper we present the phase and morphological characteristics of urinary stones from Serbian patients. The study included for the first time the determination of the phase composition and a statistical analysis of the presence of different types of urinary stones in both men and women in Serbia. This is important study because for the first time, these kinds of data are present. The analysed samples were collected from patients from different parts of Serbia (without Kosovo). During this period, 246 samples were collected. Methods used for the investigation of urinary stones were X – Ray powder diffraction (XRD) and scanning electron microscopy (SEM). By XRD analysis a total of 246 samples were analyzed and 4 samples were examined by SEM. The results showed that there are several different types of urinary stones that vary in mineral composition, chemistry and morphology. It was found that 130 (52.8%) of the 246 stones were composed of calcium oxalate minerals (CaOx): 40 (16.2%) of which were pure calcium oxalate monohydrate (COM), 9 (3.7%) were pure calcium oxalate dihydrate (COD); 86 (35%) were a mixture of CaOx and calcium phosphate (CaP) minerals, 7 (2.8%) were Uric acid (UA), 7 (2.8%) were a combination of UA and CaOx minerals, 12 (4.9%) were combination of Struvite (St), CaP and CaOx, 1 (0.4%) were cystine (Cy), 3 were (1.2%) pure CaP stones.

The obtained data show the diversity of types of urinary stones. Morphological, crystallographic and statistical obtained data show a strong resemblance with those obtained in other developed countries.

Keywords: urinary tract, urinary calculi, X – Ray diffraction, scanning electron microscopy, statistics.

4-1

Design of novel oxygen reduction reaction electrocatalysts guided by systematic study of atomic adsorption on graphene through the Periodic Table of Elements

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Rational design of new electrocatalytic materials requires synchronized theoretical and experimental approach. While theory enables rapid screening of a large number of possible candidates for novel electrocatalysts, the final judgment is always given by the experiment. Here we focus on the development of novel noble-metal free carbon-based electrocatalysts for oxygen reduction reaction (ORR). First, we applied Density Functional Theory (DFT) calculations to investigate atomic adsorption on pristine and vacant graphene (considered as a model of disordered carbon), covering all the elements in the Periodic Table with atomic number below 86 (excluding lanthanides). This allowed us to identify the elements which strongly anchor to (vacant) graphene surface and form systems which are stable under harsh electrochemical conditions of ORR. Based on the obtained results we selected several M-doped carbons as possible new ORR electrocatalysts. Next, we performed rigorous DFT calculations addressing the mechanism of ORR on these M-doped carbons. These calculations confirmed that ORR activity should be improved by inclusion of selected metal atoms in carbon structure. Finally, we have prepared series of mesoporous carbon (MC) materials doped with ultra low concentrations of metals pre-selected by DFT modelling, particularly Co and Ni. Experiments confirmed that the ORR activity of Co,Ni-doped MCs display significantly higher ORR activity compared to pure MC and improved selectivity towards O₂ reduction. An improved selectivity, experimentally observed at high ORR overvoltages, was in agreement with strong interactions of ORR intermediates predicted by modelling of the mechanism of ORR on Co- and Ni-doped graphene.

4-2

DFT investigation of monoatomic catalysts supported by graphene substrates

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Graphene, the 2D layer of hexagonal carbon atoms, possesses a vast array of desirable physicochemical properties. While rather inert to covalent chemical bonding, introduction of defects into pristine graphene surfaces is an approach that enables the creation of sites with highly localized chemical reactivity [1,2].

In this work, a DFT approach was used to probe the interaction of various platinum group and coinage metal single atoms with the pristine, monovacant, and substitutionally doped graphene substrates. The doping was performed with B and N, as they introduce the least deformation into the lattice upon doping, while changing the local electronic structure. The bonding energetics and character is described, and the mobility of atoms across the surface is predicted. This is of high importance when considering single atom catalyst systems, as good anchoring of atoms is needed to prevent agglomeration of catalytic species. To probe the reactivity of atoms at their most stable positions, we then investigated the interaction of these metal-graphene systems with some of the chemical species often found in heterogeneous and electrocatalysis, such as O_2 , OH^- , H^+ , NH_2^- , SH^- , CH_3^- , etc. Local modification of reactivity that was observed points towards careful selection of very specialized systems for a particular catalytic reaction, based on the metallic adatom – graphene substrate combination.

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4-3

**Doped graphene as an electrode material in novel metal-ion batteries:
the importance of the oxidation level**

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A good electrode material for metal-ion batteries should exhibit high electrical conductivity, strong-enough, reversible interaction with the metal ions in question, (without metal precipitation), and good stability in the given working conditions. While pristine graphene can seem like a great choice in terms of electrical conductivity, it is chemically very inert and interacts weakly with species of electrochemical interest, restricting its use in electrochemical energy conversion and storage applications. However, its performance can be enhanced by changes in the electronic structure of carbon atoms in graphene induced by the presence of defects on its basal plane. The defects can be in the form of dopant atoms, vacancies, surface functional groups, or corrugations of the graphene layer. Due to the difficulties that Li-ion batteries are facing, the attention of the electrochemical community is turning towards sodium and multivalent metal-ion batteries. In this contribution we use Density Functional Theory (DFT) calculations to demonstrate how the presence of various defects on graphene affects its electronic structure and the interaction with the metals of electrochemical interest: Na, Mg, Al and Zn. The investigated defects include a monovacancy and substitutionally introduced dopant atoms: boron, nitrogen, phosphorus and sulphur. The influence of the oxygen-containing groups, which are often present on such surfaces, is discussed.

4-4

**Structural properties and antisite defect formation
in monoclinic $\text{Li}_2\text{FeSiO}_4$ – a DFT aspect**

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Properties of monoclinic $\text{Li}_2\text{FeSiO}_4$, which is a prominent candidate for future use as a cathode in lithium ion batteries, have been investigated by DFT+U method, using GGA-PBE approximation, plane wave basis set and periodic boundary conditions. All calculations were performed in an antiferromagnetic state, which has been found to be energetically slightly more stable than ferromagnetic. Optimized lattice parameters and atomic coordinates have been compared to the literature data in order to verify the model. In addition, a particular attention was paid to the possibility of the formation of an antisite defect, which was introduced as the interchange between Fe and Li ions at both Li1 and Li2 crystallographic positions. The concentration of defect was varied from 0 to 25 molar per cent. Changes of structural, energetic, and magnetic properties of monoclinic $\text{Li}_2\text{FeSiO}_4$ upon increase of Li1-Fe and Li2-Fe antisite defect concentration have been analyzed and discussed in light of available experimental results.

4-5

Investigation of wave propagation in single crystals of heat-resistant nickel alloys

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The development of modern aviation gas turbine engines (GTE) has led to the need to create special heat-resistant nickel alloys for casting single-crystal gas turbine blades operating under extreme conditions (high temperatures - about 0.8T_{pl}, extreme mechanical stresses, long-term operation up to 10,000 hours, aggressive media). The current trend in the development of foundry heat-resistant nickel alloys is the use of scarce elements such as rhenium and ruthenium. The use of rhenium and ruthenium will ensure an increase in the operating temperature by 50–60 °C of single-crystal blades made of these alloys. The alloy is characterized by auxetality (negative Poisson's ratio — the ability to experience deformation of the same sign in the perpendicular direction as that of the load) in some directions, as well as the difference of elastic constants 2.5 times along some directions. Due to the significant anisotropy of the mechanical properties of single crystals of heat-resistant nickel alloys, the tensile strength characteristics will depend on the crystallographic orientation. Therefore, to calculate the structural strength of single-crystal blades and the resource design of a gas turbine engine, data are used on the temperature-orientation dependence of the elastic and strength properties of these alloys, such as Young's modulus, Poisson's ratio, yield strength and strength along the crystallographic axes. By numerical modeling, wave patterns of deformation of targets from a heat-resistant nickel alloy of V generation VZhM8 were obtained under shock loading by an aluminum projectile with a velocity of 212 m/s. The mechanical properties used in the calculations were determined in [1] at the operating temperature of 8000 °C. The velocity profiles of the back surface of the target from the VZhM8 alloy were obtained for cases of shock loading in the (001), (111) and (011) crystal directions with an initial velocity of 212 m/s.

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4-6

The effect of disorder on the density of electronic states of two-layer AB graphene

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The density of electronic states (DOS) of disordered AB bilayer graphene was investigating in the frame of the disordered nanomaterials model (with short-range order). The methods of quantum field theory (the method of temperature Green's functions) was using for obtaining analytic expressions of electron relaxation time and the contribution to DOS from scattering of electrons on impurities and structural inhomogeneities of the short-range order type. Both expressions had the dependence on impurity concentration, the type of defects configuration and temperature. In the absence of external field, a gap in the DOS near the Fermi level does not appear for any configuration of defects in structure. Thus, the disordered AB bilayer graphene always remains a metal. However, the different configurations of impurity atoms in bi-graphene have a different effect on the DOS, which can differ by a factor of 5 near the Fermi level at the same concentration of foreign atoms and temperature.

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5-1

Comparative properties of composite poly(lactic-co-glycolic acid)/poly(acrylic acid) implants synthesized using ultraviolet and gamma irradiation

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Composite implants comprising a biodegradable hydrophobic polymer matrix and crosslinked hydrogel with fixed ion exchange groups are promising materials for the construction of controlled drug delivery systems. Poly(lactic-co-glycolic acid)/poly(acrylic acid) (PLGA/PAA) composite implants in our study were synthesized using the sequential application of irradiation and immersion precipitation. Precursor solutions with all functional components were dispensed into a disc-shaped non-stick mold and cured either by ultraviolet (UV) or gamma irradiation. Cured disks were subsequently immersed in the phosphate buffer saline bath to finalize phase separation and solidification of the implants. The synthesized implants were characterized by FTIR-ATR and DSC, and their basic properties such as ion exchange capacity, swelling degree, and swelling kinetics were examined. Synthesis using gamma irradiation resulted in implants with similar ion exchange capacity, but the greater swelling degree and faster swelling kinetics compared to the implants prepared with UV irradiation. Gamma irradiation also resulted in altered and less homogeneous chemical composition compared to the implants synthesized with UV irradiation. Further investigations are required to determine the differences in drug release kinetics and degradation behavior of the synthesized implants.

5-2

Determination of the effective diffusivity coefficients of naringin esters

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Naringin is flavonoid glycoside found in citrus fruits, known for its numerous biological effects [1]. Its low solubility and reduced antioxidant activity in lipophilic products could be improved by acylation. Hereby, lipase-catalyzed transesterification of naringin with avocado oil (rich in oleic acid) and evening-primrose oil (rich in gamma-linolenic acid) was performed and diffusion of synthesized esters from gel-emulsion, using Franz diffusion cell and cellulose acetate membrane, was examined. After 45 hours, 25-30% of all esters from donor compartment were detected in receptor chamber and their effective diffusivities were of the same order of magnitude - 10^{-8} cm²/min [2]. For evening primrose oil, significant influence of gel-forming polymer chains relaxation was observed, while mass transfer of avocado oil derived esters was diffusion-controlled. In both cases ~1-1.5h long *lag*-phase in trans-membrane delivery of esters was present. Obtained results indicated that both analyzed mixtures could enable controlled release of naringin esters from cosmetic formulations.

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5-3

Enzymatic synthesis of naringin esters using natural oils as acyl donors

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Flavonoids are an important group of naturally occurring polyphenol compounds with significant biological properties: antioxidant, anti-inflammatory, anticarcinogenic, antibacterial and immune-stimulating [1]. Naringin, a flavanone-7-*O*-glycoside mostly found in citrus fruit, features several biological and pharmacological functions making it suitable for use in pharmacological and cosmetic products [2]. The main goal of this study was structural modification of naringin into fatty acid esters throughout lipase catalyzed acylation, using the natural oils (avocado oil and evening primrose oil) as a donor of acyl groups, in order to increase its solubility, stability and potential biological activity in lipophilic systems, while simultaneously providing better efficiency and cost-effectiveness of esterification process. After 73.5 h the achieved conversion degree in esterification with avocado oil was 66 %, while the conversion degree of 80% was achieved using evening primrose oil. As expected, naringin oleate (3.92 mg/ml) and naringin linoleate (4.39 mg/ml) were the main products, respectively.

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5-4

Tellurite glasses: potential transparent radiation shielding materials

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A series of tellurite glasses in the $\text{WO}_3/\text{Bi}_2\text{O}_3\text{-PbCl}_2\text{-TeO}_2$ systems were synthesized to evaluate their use as potential transparent radiation shielding materials. In addition to the characterization of optical, physical and structural properties of these glasses, the radiation shielding properties, such as mass attenuation coefficient (μ/ρ), half value layer, mean free path and effective atomic number values were investigated within the energy range of 0.015 MeV–15 MeV using MCNPX code. Consequently, the calculated shielding parameters of tellurite glasses were compared with ordinary concrete and different glass systems and it was found that the shielding properties of the studied glasses are comparable or even better than current commercial materials.

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5-5

Solvothermal synthesis of kaolinite nanoscrolls

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The modification of kaolinite structure through multi-step intercalation is an important research field, where, among others, kaolinite plates can be converted into nanoscrolls, which can be applied in advanced nanocomposite materials. These halloysite-like nanoscrolls are produced by multi-step intercalation, where first, a suitable guest molecule (e.g. dimethyl sulfoxide) is inserted into the interlayer space of kaolinite, and subsequently it is displaced by other compounds. Using intercalation and deintercalation steps, kaolinite layers can be exfoliated, i.e. they can be separated into individual double layers. To compensate stresses due to misfit of tetrahedral and octahedral sheets, the exfoliated kaolinite layers curl and then frequently roll to form nanoscrolls.

In this work, we investigated the multi-step intercalation of kaolinite, and we wanted to develop such a procedure for formation of nanotubes, which requires less time, fewer steps and less reagent volume. Kaolinite-dimethyl-sulfoxide and kaolinite-urea precursors were used to produce directly kaolinite-cetyltrimethylammonium chloride (kaolinite-CTAC) complexes using solvothermal methods. The prepared kaolinite-CTAC complexes were suitable for the exfoliation of kaolinite and the formation of kaolinite nanoscrolls. The formation of kaolinite complexes and nanoscrolls was investigated using X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FT-IR), thermogravimetry (TG), scanning and transmission electron microscopy (SEM, TEM).

5-6

**The influence of the chemical modifications on the
AC specific electrical conductivity of the jute woven fabrics**

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In order to obtain jute fabrics with high AC specific electrical conductivity, the raw jute woven fabric was chemically modified. Namely, alkali modification with 17.5% NaOH at room temperature for 5 and 30 min was performed for progressive removal of hemicelluloses, while oxidative modification with 0.7% NaClO₂ at boiling temperature for 15 and 60 min was used for progressive removal of lignin. The chemical composition of the chemically modified jute fabrics was determined by successive removal of non-cellulosic components, after that, the α -cellulose remains as a solid residue. The moisture sorption was determined according to thermo-gravimetric method. As very important indirect indicator of the tendency of the fibrous materials to generate static charge, AC specific electrical conductivity was measured in the frequency region between 30 Hz and 140 kHz at 30% relative air humidity.

After the alkali modifications, the content of hemicelluloses decreased from 21.76% for unmodified to 12.34% for alkali modified jute fabric, while after the oxidative modifications, the content of lignin decreased from 13.48% for unmodified to 4.98% for oxidative modified jute fabric. The moisture sorption of the alkali modified jute fabrics is about 21.6-26.6% higher compared to the unmodified jute woven fabric. Oxidative modification of jute fabrics slightly increased their moisture sorption (3.2-12.5%). Since, the fabric is heterogeneous three-phase system, it was suggested to refer it as the capacitance of “fiber-moisture-air” system. In that context, the AC specific electrical conductivity is very sensitive to fabrics chemical composition and moisture sorption. The lowest AC specific electrical conductivity was noticed for the untreated jute fabric, which can be related to its highest content of hemicelluloses and lignin and the lowest moisture sorption. Chemically modified jute fabrics have higher values of AC specific electrical conductivity compared to unmodified jute fabric. For example, 36.6% lower content of hemicelluloses (modification with 17.5% NaOH for 5 min) in comparison with unmodified fabric resulted in increased value of AC specific electrical conductivity from 0.095 μSm^{-1} to 0.79 μSm^{-1} (at around 140 KHz). Jute fabric with 37.7% lower content of lignin has lower value of AC specific electrical conductivity (0.7 μSm^{-1}). The higher AC specific electrical conductivity of alkali modified jute woven fabrics can be explained by the presence of water in form of moisture, leading to increase the number of the polar groups, which facilitate the flow of current through the amorphous regions, as well as the crystallite’s surface regions.

The obtained jute fabrics with higher AC specific electrical conductivity can be successfully used for protective clothes or textile of specific behavior in environments sensitive to

electrical discharges, home textiles (carpet), filters (static charge causes impairment of filtering properties as well as the fire risk that can be caused by the spark appearance), etc.

Keywords: jute, chemical modifications, hemicelluloses, lignin, AC specific electrical conductivity.

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5-7

**Potential application of pharmaceutical waste:
oxaprozin as corrosion inhibitor on aluminium alloy AA2024**

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Oxaprozin, 3-(4,5-diphenyl-1,3-oxazole-2yl)-propanoic acid, belongs to the class of non-steroidal anti-inflammatory drugs (NSAIDs) with analgesic and antipyretic properties. Since it was observed that it forms complex compounds with various metals, the goal of this research was to investigate its potential adsorption on aluminium surface hence providing corrosion inhibition properties. Oxaprozin as active component of Duraprox® tablets, was adsorbed on AA 2024 surface in molecular or ionic forms (obtained by neutralization of carboxyl group). Influence of different drug concentrations and temperatures on its corrosion inhibition properties was tested. Corrosion of aluminium alloy AA2024 in 3 wt. % NaCl solution was investigated using electrochemical impedance spectroscopy and linear sweep voltammetry. Electrochemical impedance spectroscopy measurements showed that oxaprozin was adsorbed on aluminium surface therefore providing protection from electrolyte. Tafel polarization technique revealed that oxaprozin behaves as anodic inhibitor, since no change in cathodic current was observed.

5-8

**Investigation of the effect of different surface preparation
on X42CR13 prior to PVD coating on wear resistance**

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Surface engineering is a field related to science and technology of modifying surface characteristics as per requirements to enhance the life of the engineered products (mechanical components) while operating. The broad classification of surface engineering can be done in two groups: surface modification and surface coating. In surface modification the properties of the surface are changed by the application of heat treatment techniques, microstructural changes, ion implantation whereas in surface coating a new layer is added on to the substrate.

The presented research work deals with the investigation of the friction performance of the surface layers having different surface preparations before coating on the substrate i.e. Polishing (P) and Glass bead blasting (GBB). The aim is to determine the effect of different surface preparation prior to the application of coating (PVD produced DLC layer) on the wear/ friction behaviour of the samples. Surface preparation is the essential first stage treatment of the substrate before applying coating. The performance of the coating is significantly influenced by its ability to adhere properly to the substrate material. The presence of even small quantities of contaminants such as dirt, grease, oxides etc can physically impair and reduce coating adhesion to the substrate. Hence it is a well-established fact that correct surface preparation is the most important factor affecting the bulk properties of the substrate and behaviour of coating.

The base material is X42Cr13/W i.e. plastic mould tool steel. Firstly, disc shaped sample (diameter 50 mm and height 10 mm) was cut from a steel rod. Grinding was carried out to provide parallel surface and then after precipitation hardening was done on each sample. Nitriding was carried out at two different temperatures i.e. 520 °C and 550 °C, holding time:8 hours, voltage:600 V, pressure 2 mbar, source of nitrogen: decomposed ammonia ($N_2:H_2=1:3$). Two different surface preparations i.e. polishing (P) and glass bead blasting(GBB) was done before the application of PVD produced DLC layer.

Ball-on disc test using the UNMT-1 tester to examine the wear/ friction behaviour was carried out on the set of samples having different surface preparation. This test records the value of coefficient of friction (μ) online using a computer proprietary software. In general in case of metals, higher the value of μ , higher is the degree of surface deterioration. The obtained result demonstrates that irrespective of the nitriding temperature glass bead blasted specimens had lower friction coefficient as compared to the polished specimens. Consequently, it can be established that the operation of GBB gives better wear resistance and better adhesion properties as compared to polishing.

5-9

Investigation of nanomechanical properties of chemically tempered glasses

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Chemical tempering, which is an ion exchange process that aims to improve the mechanical strength of glasses by modification of the surface chemical structure via immersion of the glass into a molten KNO₃ salt bath, wherein small sodium ions in the glass structure are replaced by potassium ions, thereby inducing the formation of a compressive stress layer. In this study, it is aimed to mechanically strengthen commercial alumina silicate and soda lime silicate glasses using chemical tempering process at 400, 425 and 450 °C for varying durations. Accordingly, the effect of chemical tempering on nanomechanical and optical properties of glasses were investigated. Surface compression stress and stress depth profile, bending strength, scratch depth and hardness values were determined using surface stress meter, ring-on-ring tests by Instron, nanoindentation and microhardness analysis, respectively. Additionally, the changes in optical transmittance, index of refraction and surface roughness were investigated using UV/Vis/NIR spectrophotometry, ellipsometry and white light interferometry techniques.

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Keywords: ion-exchange, chemical tempering, alumina silicate glass, soda-lime silicate glass

6-1

Production of alkali activated cements using a new industrial waste source

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Alkali activated cements play an increasing role as a successful substitute of ordinary Portland cements due to their superior durability and environment friendliness. Based on the chemical composition of these binders, alkaline cements can be divided to two basic categories: high- and low-calcium cements. Most commonly used starting material for high-calcium system is blast furnace slag (BFS), which can be activated using alkali hydroxides, carbonates or silicates.

This study introduces a novel activation method to manufacture high-calcium alkali-activated cements (AACs) based on inactive air-cooled blast furnace slag (ACS), which is well-crystallized and hydraulically unreactive. To enhance its reactivity we developed a new procedure, called mechanochemical activation. Mechanochemical activation is technically an intensive grinding, where the formed amorphous phase reacts later with the alkaline solution. During experiment grinding parameters were altered (grinding time, the mass ratio of sample to grinding body, and rotation speed), and the effect of storage time on the activated samples was investigated. The structural and morphological changes of mechanochemically activated ACS were followed by X-ray diffraction (XRD), and Fourier transform infrared (FTIR) spectrometry, scanning electron microscopy (SEM), as well as determination of particle size distribution. The applicability of activated ACS in alkali activated cements was characterised using compressive strength at 28 days.

The ACS partially amorphised by mechanochemical activation proved to be a valuable component for AACs with its compressive strength around 50 MPa in mortar (even with 180 days of storage time before use) surpassing that of granulated slag (30 MPa).

Keywords: alkali activated cements, mechanochemical activation, grinding, compressive strength, air-cooled slag, storage time.

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6-2

Synthesize graphene foam as anode materials for lithium ion batteries

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Recently, the three dimensional graphene based materials ranked as high attractive synthesized component that not only possess the intrinsic properties but also include some applicable characteristics such as high specific surface area, significant electrical conductivity, low density and superb mechanical properties. Moreover, graphene are using as an excellent layered material and scaffold or a doped component composited with micro-/Nano-architectures to form three-dimension (3D) structures with versatile functions. There were several research have been launched to assemble 2D graphene sheets into 3D structures for some targets like energy storage and conversion, supercapacitor conductor, field-effect transistor biosensor, catalyst, strain sensing and lithium ion batteries. The assembled 3D graphene materials may not only provide inherently excellent properties of 2D graphene sheets, such as high electronic, optical and catalytical properties, but also exhibit huge specific surface area (SSA), strong mechanical strength, high electron conductivity and fast mass transport kinetics. In this study, the different characteristics of graphene foam have been evaluated due to the various production procedures. 3 different reducing agents are considered to provide graphene fome based on the hydrothermal process, which are ammonia, ascorbic acid and HI. The graphene aerogel reduced by HI possesses the worst mechanical strength while the graphene aerogel prepared with ammonia is very sensitive to the reaction time and temperature compared to other reducing agents. Although the graphene aerogel reduced by ascorbic acid had the best mechanical strength. Furthermore, the graphene aerogels showed excellent electrical conductivity in comparison of 3D graphene networks. The target of this research is to find the best candidate as the anode materials in lithium ion batteries. All of the 3 samples were analyzed by using characterization and performance devices. The electrical conductivities of graphene aerogels which is synthesized from 3 reducing agents were measured by four-probe method with metal electrodes attached to the ends of samples. Electrical current was passed through metal electrodes attached to end of the graphene aerogel, and the voltage drop was measured over the aerogel. The obtained graphene aerogels from ammonia showed excellent electrical conductivity rather than two others but since the mechanical property was another preference, it is found that the graphene foam which is provided by ascorbic acid as reducing agent could be the optimum production.

Keywords: 3D Graphene Oxide, Graphene Aerogel, Graphene Foam, Reducing Agent, Hydrothermal Process, SEM, Raman Spectroscopy, Electrical Conductivity, Mechanical Property.

6-3

Technological restrictions at 3D printing with Zortrax M200 3D printer

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3D printing has numerous advantages over traditional manufacturing techniques, including single step manufacture, low cost, complexity freedom, design freedom etc. Nowadays, this technology has many applications in different fields: engineering, medicine, architecture, art, jewelry, practically everywhere. Small or large parts, all of them can be manufactured using a 3D printer. Depending on the mechanical properties of the material used and the technical specifications of the printing process, such as temperature, printing speed and density, the printing quality can be different. The aim of this paper is to examine the accuracy (to what extent the 3D print fits to the 3D model) and the precision (who establishes the consistency of the measurements) for small-sized plastic parts printed on Zortrax M200 3D printer. Also, the results of the experimental work on the capabilities and limitations of printing technology using this printer are presented in this paper. Several parameters such as surface quality and strength, layer shifting or misalignment are closely studied.

6-4

Alkali activated cement foams as catalyst supports

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Alkali activated cements as new types of binders can easily be foamed. These foams are eco-friendly porous materials, which have good mechanical and chemical stability, high temperature resistance, etc. The foams with sufficiently high open porosity (~ 70 vol %) can be used as catalyst supports for photocatalytic sewage treatment processes. However, the low compressive strength and the high cracking tendency of the foams limit their application potentials.

The aim of this study was optimize the strength-porosity relationship of alkali activated inorganic polymers foams (AAIPFs). Metakaolin based geopolymer foams were produced by gelcasting/saponification/peroxide decomposition (GSP) combined method using sunflower oil as surfactant and H₂O₂ as foaming agent. This combined route allowed the production of AASP foams with designed porosity. The organic matter content of the samples is a major problem, which can be reduced by the reduction of oil content and by calcining the specimen with appropriate firing parameters. Although the samples have good compressive strength, visible hairline cracks appear on their surface and also microcracks inside of them. These problems can be resolved by several ways, e.g. by the addition of more precursors and/or, fiber reinforcement also, changing the storage conditions, the washing parameters and/or the curing temperature and time. Based on experiments the optimal composition and experimental conditions were chosen. The crack-free samples may be suitable for photocatalytic experiments after removing the organic matter content (with appropriate washing, drying and firing parameters). Furthermore the relationship between strength and structure was investigated, using FT-IR, XRD and SEM. The produced crack-free AAIPFs can be used as catalyst supports in photocatalytic degradation processes.

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6-5

Possibilities of destruction of hazardous waste piralen

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Polychlorinated biphenyls are of great importance in the production of plastics, synthetic solvents, pesticides and synthetic transformer oils, in the production of insulating materials, paints, varnishes, lubricants, adhesives, hydraulic oil oils, printing colors, working fluids for heat transfer and other. Transformer oils are non-degradable and belong to extremely hazardous environmental pollutants and are classified into group 2A chemicals with probably carcinogenic effects per person. By penetrating the soil permanently pollute the soil and groundwater. By burning them outdoors, a large number of toxic carcinogens are released. It is permitted to use transformers operating in normal operating mode without disturbance and leakage of oil and contain pyralene or polychlorinated biphenyls between 50 and 500 ppm, but their decontamination is required by 2025. Therefore, the obligation was imposed on appropriate procedures to destroy or dechlorinate the transformer oils with dielectric fluids (pyralene, polychlorinated biphenyls). The decontamination product should be a transformer oil with a concentration of dielectric fluid below 50 ppm. The aim of the work is to apply the appropriate degradation technology, ie, decontamination of pyralene or polychlorinated biphenyls. The results of decontamination of transformer oil of PCB at concentrations of about 500 ppm, using base catalyzed destruction, contain all the elements of the best available technology and the best ecological practices of pyralene desertification. The decomposition of pyralene is a dependable process from the concentration of the applied neogene base. In order to purify the treated transformer oil, adsorbents are used: zeolite and activated carbon.

6-6

Deposition of bioactive coatings onto polylactide materials: comparison of methods

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Development of various methods of bioactive coatings deposition onto polylactide films attracts a lot of attention due to being a widely used as scaffolds for tissue engineering polylactide materials suffer of poor surface properties, such as hydrophobicity and a lack of specific sites promoting cell adhesion and growth. This work is aimed to explore various methods of deposition of polysaccharides (hyaluronic acid and chitosan) and proteins (collagen type I) onto polylactide-based materials (films and non-woven micro-/nano fibrous mats). A number of techniques, such as chemical entrapment (pre-treatment of polylactide by solvent mixture), plasma surface activation of polylactide prior incubation in polysaccharides/protein solutions, electrospray deposition and electron-beam sputtering, were studied in terms of surface morphology (scanning electron and atomic-force microscopy), chemical structure (FTIR and X-ray photoelectron spectroscopy) and hydrophobic/hydrophilic balance (goniometry). The reported study was funded by RFBR according to the research project № 18-32-00901.

6-7

The study of the applicability of flotation agents based on derivatives of oxane for an enrichment of fine coal particles

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At the process of coal mining, in all mining enterprises, the part of the fine fraction can reach 2-4%, which doesn't find it any application and accumulates in the dumps. Nowadays only the froth flotation is one of the effective ways to the processing of coal fine fraction, which based on the differences of the physicochemical properties the surfaces of coal and rock particles. A preliminary patent analysis on this field showed us that other methods of coal wastes enrichment such as a foam separation or oil agglomeration didn't receive a practical distribution.

One of the determining factors which ensure the completeness of extraction of organic mass of coal at froth flotation is the composition of flotation reagents, as well as their availability and reasonable cost. And the aim of this investigation was the study of the possibility of using flotation reagents based on oxane and derivatives of 1,3-dioxane, which were synthesized from an oil processing waste, for the enriching of fine coal and coal sludge. Our preliminary studies have shown their high efficiency in froth flotation of polymetallic raw materials and schungite minerals due to the dual effect. The main part of molecules of these flotation agents, adsorbing at the liquid-gas boundary, is a foaming agent, and the other part, being fixed on the surface of the mineral, plays of the role of a collective agent.

The object of the study was a coal waste from "Saryadir" deposit (Kazakhstan) with high minerals content up to 43%.

For investigation were used modern methods of analysis: raster, and Raman- spectroscopy, differential-thermal, and chromatographic analysis.

As traditional flotation reagents, which use in the coal industry were applied the pine oil with kerosene and for a compare, the flotation agents which was synthesized by authors on the basis of oxane (3-miltetrahydropyran-4-ol) and (3-amyltetrahydropyran-4-ol). Reagents were obtained by oximethylation of octene with paraform. Schematically, the process of synthesis can be represented by two stages. The first stage is oximethylation of olefin with paraform, and the second stage is alkaline hydrolysis of acetates, which were obtained at the first stage.

The flotation enrichment was carried out according to the traditional scheme in a flotation machine with a 50 ml chamber and obtained dry concentrate was heated in a muffle furnace to determine the ash content according to the standard of ISO 1171-97.

In order to determine the efficiency of the flotation process, the following values were calculated: the yield of the product, the content of carbon and mineral components.

The obtained results showed that when we used traditional flotation agents the yield of foam product increases just only up to 3 minute times after then the flotation process was stopped. At the same time, when we used synthesized flotation reagents, the possibility of recleaning

operations has appeared. The best results were achieved when using a reagent based on 3-amiltetrahydropyran-4-ol, where the extraction of coal with the yield of coal component up to 85% and a decrease in ash content up to 2 times was achieved.

The study showed the prospects of the applicability of new flotation reagents synthesized on the basis of octanes class for the process of flotation enrichment of fine coal.

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6-8

Hydrogenation of exhaust resource storage of explosives nitroaromatic series with the purpose of their utilization

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The processes of hydrogenation of aromatic nitrocompounds on fiberglass woven catalysts for chemical disposal of demilitarized TNT and other compounds of nitroaromatic series, as well as for creation of new technologies of obtaining complex amines and their derivatives on the basis of these processes were developed. The method of chemical disposal of a demilitarized explosive 2,4,6-trinitrotoluene (TNT), based on the restoration of TNT to 2,4,6-triaminotoluene (TAT) were proposed. TAT is the basis for creation of competitive products and materials with a valuable combination of important practical properties. This is new and unique component for sewing foams, effective foaming fire retardant compositions on the basis of condensation products TAT with formaldehyde, a known technical product of wide purposes - methylfloroglycine (MFG) and a new stable condensing monomer (diamine) with a free hydroxyl group - 4-hydroxy-2,6-ditoluidine. On the basis of data available the ecologically safe technologies of the closed cycle of these products and materials production, which may be applied at atmospheric pressure, low temperatures (up to 100°C), in water as a reaction medium were developed. Currently obstacle to obtaining these products with the low price is existing periodic process of catalytic hydrogenation of TNT to TAT using powder catalyst - palladium on carbon media. Large expenses of catalyst and large deadweight loss of metal palladium make this method little profitable. On the basis of proposed method a new progressive technology of liquid-phase hydrogenation of organic nitro compounds, based on restoring of the aromatic nitrocompounds to the corresponding amines on catalysts of new generation on the basis of fiberglass woven media, which was implemented for the purposes of utilization of nitroaromatic explosives (first of all, trinitrotoluene). The application of this approach for catalytic reduction of aromatic nitrocompounds to the corresponding amines allows providing the following advantages, in comparison to the traditional processes:

- implementation of a three-phase catalytic process in compact high-performance reactors of a new type of glass woven cassette catalysts will lead to the exclusion of traditional powder catalysts and related filtration stage. This will also provide high specific velocity of the process and, as a consequence, a substantial simplification of the aromatic nitrocompounds hydrogenation technology, as well as reduction of capital and operating costs during implementation of the technological scheme.
- automated continuous technology of production and regeneration of catalysts usage gives the flexibility to change modes and receive catalysts highly reproducible at considerable simplification of the technologies for production and implementation of the technological scheme.

7-1

Thermoelectrics and spintronics of organic semiconductors

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Carbon based conjugated organic polymers and molecules have become ubiquitous in applications for electronics such as OLED displays, printed logic circuits and solar cells. Their applications in the fields of thermoelectrics for waste-heat-to-electricity conversion and in spintronics for energy-efficient computing devices are however relatively new and are poised to define the trajectory of research on organic semiconductors over the next few years. This talk will focus on robust measurements of thermoelectric transport as well as spin transport in organic polymers, spotlighting the fundamental physics of these molecular systems.

When a temperature difference is applied across an organic polymer semiconductor, a thermal voltage is generated across it in response. This thermal voltage divided by the applied temperature difference is a fundamental transport parameter called the Seebeck coefficient and represents the entropy per charge carrier within the material. On account of disorder within solution processed organic semiconductors, the value of the Seebeck coefficient is a few hundred $\mu\text{V/K}$, several times larger than the fundamental unit k_{B}/e , where k_{B} is the Boltzmann constant and e is the fundamental charge. In the first half of this talk, measurements of the Seebeck coefficient within the channel of an organic field-effect transistor shall be shown, and its implications for understanding energetic disorder shall be highlighted [1], [2]. In addition, it shall be shown how gate-modulated Seebeck measurements can act as a test bed to validate novel charge transport mechanisms in organic polymers [3].

Another often overlooked property of organic semiconductors is their low spin-orbit coupling on account of their composition from lighter elements such as carbon. Low spin-orbit coupling reduces the effect of the de-coherence of spin information as spins propagate through a conjugated polymer and in theory, should lead to long spin diffusion lengths. Despite this, decades of research on organic spintronics using organic spin valves have measured spin diffusion lengths of only a few tens of nanometres. The second half of this talk shall outline our attempts at using novel nanofabricated device architectures for organic spintronics to probe lateral spin transport through organic polymers. The devices use spin pumping as a technique to inject a spin current, and the inverse spin Hall effect as a detection scheme. These results are the first experimental validation of carrier modulated spin transport in organic polymers where spins traverse the polymer via an exchange enhanced spin transport mechanism. Under these conditions, spin diffusion lengths of over $1\ \mu\text{m}$ can be measured, opening up new opportunities for organic polymers in spintronics and spin-based information processing [4].

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7-2

Welded silver nanowires as transparent electrodes in optoelectronics

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For their ease and cost-effectiveness of synthesis and processing, silver nanowires (AgNWs) have been extensively studied as a transparent electrode alternative to conventional solutions like indium tin oxide (ITO) for the application in optoelectronic devices like solar cells. The main focus of this research was elucidating the solid-state wetting and welding mechanisms that occur during annealing of AgNWs before a layer of aluminum doped zinc oxide (AZO) is deposited on them, for the enhancement of properties essential for an electrode in a solar cell. Microstructural characterization using scanning electron microscopy (SEM) and scanning transmission electron microscopy (STEM) revealed that, during annealing, the AgNW in contact through a smaller radius of curvature dissolves, Ag atoms diffuse and are incorporated in a welded zone between the AgNWs whose crystallographic orientation is inherent from the AgNW in contact through a large radius of curvature. Wetting angle between two welded AgNWs was measured to be below 4.8°, indicating almost complete wetting. Tomography, based on 3D reconstruction of STEM imaging, was employed to better understand the morphology of the welded zone and geometric relationship between the AgNWs. Electron diffraction orientation and strain mapping were performed in order to elucidate possible strain fluctuation across the AgNWs. Crystal lattice distortion, directly measured by atomic column displacements in drift corrected cross-sectional atomic resolution STEM images of an AgNW, prepared by focused ion beam (FIB), demonstrated non-uniform distribution of strain in five twin segments of the AgNW. It has been demonstrated that welding of AgNWs significantly reduces electrical resistivity while preserving high optical transparency, properties essential for transparent electrodes utilized in solar cells.

7-3

Processing and characterization of $\text{Bi}_{0.5}\text{Na}_{0.5}\text{TiO}_3$ piezoelectric ceramics

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Nowadays, the world is facing a lot of problems by using conventional energy to produce electricity. Piezoelectric energy harvesting is attracting a lot of attention due to the interest to replace fossil fuels with new and green energy sources. Lead-based materials, represented by lead zirconate titanate (PZT) are the most widely used materials for piezoelectric energy harvesting devices. However, due to toxicity of lead, which is causing serious environmental and health problems, there is need for their replacement with lead-free materials. Bismuth sodium titanate ($\text{Bi}_{0.5}\text{Na}_{0.5}\text{TiO}_3$) is considered as a promising candidate to replace lead-based ceramics due to its good piezoelectric properties. It has perovskite structure, high Curie temperature and good ferroelectric characteristics.

Bismuth sodium titanate powders were synthesized by using hydrothermal method in alkaline environment. Bismuth nitrate pentahydrate ($\text{Bi}(\text{NO}_3)_3 \cdot 5\text{H}_2\text{O}$), titanium butoxide ($\text{C}_{16}\text{H}_{36}\text{O}_4\text{Ti}$) and sodium hydroxide (NaOH) were used as starting materials, and distilled water with addition of HNO_3 was used as a solvent. The powders were dried, calcinated and pressed into pellets. The pressed pellets were sintered at different temperatures up to 1150 °C. X-ray diffraction (XRD) analysis, Raman spectroscopy, scanning electron microscopy and dielectric measurement were used for characterization of the material.

7-4

X-ray spectra and electronic structure of the $\text{Ca}_3\text{Ga}_2\text{Ge}_3\text{O}_{12}$ compound

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The X-ray spectral studies of the $\text{Ca}_3\text{Ga}_2\text{Ge}_3\text{O}_{12}$ garnet have shown that the top of the valence band (near the Fermi level) is formed mainly by the outer electron p–states of gallium, germanium and oxygen, which intensity is sufficiently low.

The middle of the valence band is formed by the Ga 3d – states with the 2s – states of oxygen lying below them. These states are hybridized with the 4p–states of gallium and germanium as a result of which they are seen as $\text{K}\beta''$ –satellite in $\text{K}\beta_2$ – subband of Ga and Ge.

The bottom of the valence band is formed by the 3d–states of germanium, which contribution in chemical binding is insignificant.

Alignment of the X-ray emission bands of gallium and germanium with photoelectron spectrum of valence electrons of the $\text{Ca}_3\text{Ga}_2\text{Ge}_3\text{O}_{12}$ compound demonstrated satisfactory correspondence.

7-5

Synthesis and characterization of $\text{Na}_{0.4}\text{MnO}_2$ as cathode material for aqueous sodium-ion batteries

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The application of rechargeable batteries is growing significantly and there is a need for developing cheaper batteries with good performances. Sodium-ion batteries could be a viable option due to higher abundance of sodium against lithium mineral resources, its low price and similar principles intercalate Na^+ ions as Li^+ ions in lithium-ion batteries. Different materials as manganese oxides and vanadium oxide are used as electrode materials in sodium batteries. $\text{Na}_{0.44}\text{MnO}_2$ was regarded as one of the most promising cathode materials for sodium-ion batteries due to its high specific capacity and good cyclability.

In this work, $\text{Na}_{0.4}\text{MnO}_2$ was synthesized using glycine-nitrate method (GNM). The structure of synthesized powder was characterized by X-Ray Diffraction (XRD), while the particles morphology was examined by scanning electron microscopy (SEM) and transmission electron microscopy (TEM). The elemental mapping was performed by energy-dispersive X-ray spectroscopy (EDS). XRD results showed that the phase structure of $\text{Na}_{0.4}\text{MnO}_2$ was orthorhombic with tunnel structure. TEM and SEM micrographs of obtained powder material showed uniformed rod-like shape particles with the average lengths and widths of 300 nm and 80 nm, respectively and EDS analysis confirmed that the sample contains Na, Mn, and O in an appropriate ration. The electrochemical behavior of $\text{Na}_{0.4}\text{MnO}_2$ was investigated by cyclic voltammetry (CV) in a saturated aqueous solution of NaNO_3 at scan rates from 20 to 400 $\text{mV}\cdot\text{s}^{-1}$. The initial discharge capacity of $\text{Na}_{0.4}\text{MnO}_2$ in NaNO_3 solution was 50 $\text{mA}\cdot\text{h}\cdot\text{g}^{-1}$, while after 15 cycles its value increased for 9%. while the efficiency (the ratio of the capacity charge and discharge) was amounting to $\sim 95\%$. This indicates that material synthesized by GNM can be used as cathode material in aqueous sodium-ion batteries

7-6

Application of microwave curing on in-situ cement and concrete manufacture

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Controlling the hydration time of cement and concrete is the aim of several research in all over the world. One of the main applications of rapid concrete is repairing the flight runways and taxiways at the airports. It is become widespread to use fast hydrate concrete for these targets. Besides, cementitious or other rigid partial depth repair products are used to repair spalls in concrete pavements. The problem with these products is they can be brittle and can crack under direct heavy impact or because they have a different coefficient of expansion than the surrounding concrete. As an alternative method, Microwave (MW) radiation is an innovative, rapid and popular curing method for concrete materials. Due to the advantage of volumetric heating in this method, an important improvement in the rate of strength development can be obtained. Briefly, by using this method, the rate of hydration reaction of cement and concrete increases and the required time for necessary strength of cement and concrete can be provided in a shorter time. It is observed that the proper concrete strength can be achieved in 4 hours comparing to 48 hours by applying microwave on it. So, it would be a proper alternative method for repairing the runways in airports which are always in rush. MW curing can accelerate the hydration time to boost the compressive strength which would be applicable even in some structures such as highways or roads.

This research focused on the effect of the changes in microwave power, curing time and water-cement ratio to optimize the compressive strength of concrete and time. At the first step, experiment is done in respect to microwave power, which are 180 Watt, 540 Watt and 900 Watt. Furthermore, the effect of radiation time is evaluated by applying microwave radiation for 1, 2, 4, 6, 10, 60 min. As a final step, the water-cement ratio is changed from 0.5 to 0.3 in order to find the best strength performance. All microwave cured samples are evaluated by compressive strength test and analyzed by utilizing XRD and SEM to characterize the microstructure. Results shows by using 540 Watt microwave power for 4 minutes on cement and concrete, considering the 0.5 as water to cement ratio, the compressive strength of the pavements is highly acceptable for industrial application.

Keywords: Cement, Concrete, Microwave Curing, Fast Hydration, Runway Repair, XRD, SEM.

7-7

Rheology and compatibility study of partly cured binders for plastic explosives

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Polymeric binder is an important component of mouldable plastic explosives, binding together explosive component particles, and optionally, oxidizer and fuel. Most often used binder systems are based on some thermosetting elastomer, such as polyurethane with appropriate plasticisers and additives for enhancement of processability, mechanical and rheological properties and chemical stability.

In this study three different liquid partly cured polymer binders of desirable viscosity were prepared for use in mouldable plastic explosive: first by polyaddition of polypropylene glycol and toluene diisocyanate, second by polyaddition of hydroxyl-terminated polybutadiene and isophorone diisocyanate, and third by free-radical polymerization of polydimethylsiloxane and benzoyl peroxide. Viscosity was determined on Brookfield HBT viscometer. In order to study hydrogen bonding formation, Fourier-transform infrared spectroscopy (FTIR) was used. Temperature dependencies of rheological behaviour parameters (storage modulus, loss modulus, loss factor), glass transition temperature and viscoelastic character were analyzed. Compatibility test was conducted on differential scanning calorimeter by heating prepared explosives (mixture of each observed binder and penthrite) up to 150 °C.

7-8

Low temperature micromechanical properties of polystyrene

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Nanocomposites with polymer matrix find currently expanding applications in the different fields of industrial production. In this connection interest to plasticity and strength of matrix polymer especially in the low temperature range has increased. We studied micromechanical properties of polystyrene in the temperature range 77-295 K. Polystyrene is defined as amorphous linear thermoplastic polymer with glass transition temperature about 100 degrees Celsius.

In the temperature range of 150-295 K the dependence of microhardness was obtained. At the temperature of $T = 77$ K and close to it the deformation of polystyrene becomes reversible: during heating up to the room temperature the impressions completely disappear. The partial reversibility of impression demonstrated as the concavity of square impression edges at the unchangeable impression diagonals was observed in the temperature range of 150-190 K, whereas at higher temperatures the impression was in the form of perfect square. The complete deformation reversibility at the sample indentation in the liquid nitrogen which constitutes the adsorption-active medium is evidently connected with the forming of crazes (fibrillar-porous nanostructures); their glass-transition temperature can be tens of degrees below that of bulk polymer.

8-1

**The influence of CrAlN coating chemical composition
on detachment forces during HPDC**

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Soldering appears during the process of High Pressure Die Casting (HPDC), and it has a high impact on tool wear. This process occurs while a molten metal, commonly an aluminum alloy, is injected into the die cavity under high pressure and high velocity. To reduce machine downtime for tool maintenance, the tools surface properties are enhanced by diffusion layers and coatings. These layers are produced by plasma nitriding, physical vapor deposition (PVD) and duplex treatments (plasma nitriding and PVD). In this study, a duplex system with a hard PVD ceramic coating (CrAlN) with three different chemical compositions was examined. These types of coatings are used because of their inertness to aluminum alloys. The experiment aimed to investigate the forces needed to detach a casted aluminum alloy from coated samples using a detachment test. The casting and samples were detached using a tensile test, while the contact surface was analyzed using a Scanning Electron Microscope (SEM). It was found that substrate soldering occurred through the coating defects and caused coating delamination during the detachment test. As a result of coating delamination, a rise in the detachment forces was recorded. Analyzing the obtained results, it was found that the influence of the chemical composition of the coatings on the detachment forces was insignificant. The number of coating defects influenced those forces, due to soldering of the aluminum alloy to the substrate material through coating growth defects.

8-2

Investigation of structural and thermal properties of the Sn-Bi alloys

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Because of high toxicity of lead, lead-free solders became one of the main interests of electronic industry. Due to their low melting temperatures (eutectic point: 139°C) and low cost, the alloys from the Sn-Bi system were proposed as one of the best candidates in replacing Sn-Pb alloys in soldering. The alloys from the Sn-Bi system have also been broadly researched because of their potential application with reduced graphene oxide nanosheets as a thermal interface material, becoming very attractive because of their relatively low process temperature, high reliability, and good compatibility with substrates. In this work characterization of the structural and thermal properties of seven alloys with different compositions from the Sn-Bi system was carried out. Investigation of structural properties was performed using optical microscopy as well as SEM-EDS analysis. Phase transition temperatures were measured using DSC technique and thermal conductivities of the investigated alloys were determined using laser-flash method. Experimentally obtained results were compared with the results of thermodynamic calculations and good agreement was noticed.

8-3

**Determination of fraction of scattered X-radiation
on the radiotherapy device ELEKTA using (γ,n) nuclear reactions**

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Radiotherapy devices use fast electrons or high energy generated X-radiation for the treatment of various malignancies, the latter being much more commonly used. Although, radiotherapy is planned and performed so that the total radiation (or maximum dose) is passed on to the pathology, the small fraction is scattered throughout the entire corners. Fraction of scattered radiation increases during the life of the device. High-energy photons can produce (γ,n) nuclear reactions in surrounding materials (especially high Z), where radionuclides are susceptible to β^+ decay, which additionally increases the exposure of medical staff to ionizing radiation.

In this paper, lanthanide oxide tablets were used to determine the yield of (γ,n) reactions. Lanthanoids have been selected because they have maximum effective cross sections for this type of reaction at 15 MeV, which is energy of X-radiation used on the radiotherapy device ELEKTA at the Institute of Oncology and Radiology of Serbia. The tablets were arranged at three locations around the device and irradiated for a period of 7 days. Irradiation in the beam of the accelerator was done for 40 seconds. The yields of the resulting radionuclides were determined using the HP Ge spectrometer at the Institute of Nuclear Sciences Vinča. The fraction of scattered radiation was determined based on the comparison of yields at positions outside the radiation field and in the radiation field. This parameter is significant because it indicates the quality of collimation in the device, and therefore the quality of pathology treatment.

8-4

Surface characterization of wear resistant calender composite coatings

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The technical importance of this study is the comparison of the tribological test results from selected composite materials at different stress loads. The wear and friction properties were determined on different types of tri- bometers. The investigated composite materials are also used as functional coatings of calender rolls, whereby the surface properties have a direct influence on the quality of the final product. The composition of the investigated composite materials was systematically selected, in order to characterise the influence of the individual fillers on the tribological behavior. The research focused onto the surface characterisation of the rolling contacts at minor relative differences of the circumferential speed.

The detailed characterisation of the wear processes was carried out with 3-D microscopy, wherein the volume loss of the individual formulations and the properties of the resulting surface were analysed. Hence the principal effects of the individual additives and modifications have been described. Correlation between resin formulation and wear resistance leads to the selection of the best process parameters. Testing was supported by two-dimensional microscopic examination, hardness (Vickers and Shore D) testing and scanning electron microscopy.

Anti-stick properties and wear resistance of modified resin based epoxy matrix with mineral and polymer fillers were investigated for the roll surfaces in calenders that are used for producing various films and sheets. The wear patterns at the different relative speed differences, as well as the corresponding coefficient of friction, clarify the significant consequences of the local slip. For this purpose -as a result of the targeted use of fillers and additives- the polymer composites offer a substantial optimization potential.

Keywords: Wear mechanism, Functional coatings, Composite materials, Surface Analysis.

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8-5

Characterization of Yb:YAG laser welding AZ61 magnesium alloys

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The action of welding is a highly complex operation; it is even greater when it comes to welding magnesium alloys of these physical and chemical properties, thermal conductivity and forming a layer of magnesia which is highly refractory.

The laser by the high energy density starts to meet other welding techniques to weld the magnesium alloys. However, the behavior of these alloys to the contribution of high energy density remains unclear and is the subject of several research projects in the world.

It is in this context of understanding, that, we present this work on the laser welding of AZ61 alloy.

Yb:YAG laser beam welding with short wave length was used. The thermal effect of welding was presented. The metallurgical and mechanical characterization, using the classical observation by light and electron microscopy coupled with backscattered electron diffraction (EBSD) enabled us to access information on the microstructure of the assembly area, allowing us a better understanding of mechanical behavior of the welded joint, characterized by microhardness and tensile tests.

9-1

The ensemble effect in PtAu nanocatalysts

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Carbon supported Pt nanoparticles are the state of the art anodic catalysts for polymer electrolyte fuel cells that use hydrogen or small organic molecules (SOM) as a fuel. One of the most promising substitutes for hydrogen as a fuel is formic acid. In order to increase the activity of Pt for SOM electrooxidation, and reduce Pt loading, bimetallic catalysts have been investigated. The main issue with Pt nanocatalysts is their susceptibility towards CO poisoning. This catalytic poison is formed during SOM oxidation, and addition of second metal can affect Pt in three ways in order to reduce Pt surface poisoning: bifunctional, electronic or ensemble effect. The ensemble effect enables the change of mechanism pathway in formic acid oxidation (FAO), so that the indirect pathway of the dual path mechanism, which includes CO formation, is suppressed and the reaction proceeds preferably through direct pathway, avoiding CO formation. We have synthesized PtAu/C nanoparticles with extremely low Au content, reducing the total metal loading, and such nanocatalyst exhibited the same or even higher impact of the ensemble effect as the systems with much higher Au share. Very fine Au dispersion at Pt surface, registered by EDS and HAADF-TEM techniques, that was achieved with specific conditions of the water in oil microemulsion synthesis procedure, has proven to be the key to successful CO tolerant PtAu/C catalyst, instead of the high Au content.

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9-2

**The consolidation process and microstructure analysis
of synthesized diamonds within fractal nature analysis**

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The development of new technologies is very often based on improvement of novel materials and the features of the existing ones as well as their application. Considering that the synthetic diamonds are one of the most appealing areas of modern materials science and its modern applications, the research in this area is becoming more intensive. Therefore, in this paper, an overview of the basic properties of natural and synthesized diamonds is firstly presented followed by the method of forming and parameters that affect the final properties of polycrystalline diamonds. The first method which was used for obtaining synthesized diamonds was HPHT (high pressure high temperature) method, by which were produced diamonds very similar to the natural ones. However, CVD (chemical vapor deposition) method for obtaining polycrystalline diamond films was more promising. By applying this method microcrystalline diamond (MCD) with grain size larger than 100 nm were created. Considering that there were some disadvantages of MCD, new nanocrystalline (NCD) and ultra-nanocrystalline (UNCD) diamond materials were developed, which average size of grains were 5-100 nm as well as 3-5 nm. Depending on the consolidation process (composition and pressure of applied gases, filament setup and reactor geometry) the properties of polycrystalline diamonds can vary. Detailed analysis of these materials nature can be additionally obtained by application of the fractal analysis which is presented in this paper.

9-3

**Enhanced electrocatalytic activity for methanol oxidation
of polycrystalline platinum modified by iridium**

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Methanol oxidation reaction was investigated on polycrystalline Pt electrode electrode modified by spontaneously deposited Ir. *Ex situ* characterization of the nano-scale surface properties of the bimetallic Ir/Pt(poly) electrodes was performed by Atomic Force Microscopy and X-ray Photoelectron Spectroscopy, while *in situ* characterization was done via cyclic voltammetry in an alkaline electrolyte solution (0.1 M KOH). Activities of Ir/Pt(poly) electrodes for methanol oxidation were investigated in the same electrolyte containing 0.4 M CH₃OH and compared to the bare monometallic Pt and Ir counterparts. Ir/Pt(poly) electrode with 80% Ir coverage exhibited enhanced activity with respect to Pt, meaning that the synergistic effect was achieved. Based on the activity of obtained bimetallic electrodes for CO and formaldehyde oxidation reactions, as the most probable methanol oxidation reaction intermediates, it was proposed that carbonate and formate pathways occur in parallel. The observed enhanced catalytic activity was explained by the combination of electronic effect and by the presence of IrO_x species that promote the bifunctional mechanism.

9-4

Electrospun hybrids of carbon nanofibers with mixed metal oxide nanoparticles as high-performance battery-type supercapacitors

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The rational design of novel materials with higher energy densities and excellent cycling stability is very important for high-performance supercapacitors. Recently, the concept of hybrid nanomaterials has attracted significant attention since improved properties could be achieved in such specific architectures [1].

In this work, hybrid materials consisting of carbon nanofibers (CNFs) decorated with different cobalt and manganese oxides have been synthesized by a simple two-step process. The first step involved single-nozzle electrospinning of phase-separated polymer solutions with various quantities of cobalt and manganese acetate precursors. In the second step, the metal salt-incorporated nanofibers were heated at 600 °C in argon atmosphere thereby converting them into hybrid structures.

Scanning electron microscopy (SEM) analysis of hybrids confirmed the formation of CNFs with nanoparticles deposited on the surface of these fibers. However, scanning transmission electron microscopy (STEM) in combination with energy dispersive X-ray spectroscopy (EDS) of cross-sections of these specific hybrids revealed that metal oxide nanoparticles are present inside the CNFs as well as on the surface. Fourier transform infrared spectroscopy (FTIR) analysis suggested phase separated structures of as-spun nanofibers as typical peaks of polymers used were noted in the FTIR spectrum.

Benefiting from the unique structure, the hybrid electrodes exhibit high specific capacitance, good rate capability and cycling stability. For instance, the hybrid obtained at a Co/Mn molar ratio of 2/1 delivers a specific capacitance of about 500 F g⁻¹, at a current density of 1 A g⁻¹ in 3 M KOH, which is more than five times superior to neat CNFs. Moreover, after 1000 cycles of galvanostatic charge/discharge at 3 A g⁻¹, the hybrid sample retained 90% of its initial capacitance. The synergistic effect between metal oxides coupled with CNFs makes these hybrids attractive for high-performance electrodes for battery-type supercapacitors.

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9-5

Influence of ultrasound on morphology and anticorrosive properties of electrodeposited Zn-Co-CeO₂ nanocomposite coatings

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Metal matrix composite materials could be produced by different technologies, but electrodeposition is considered to be one of the most important technique due to low cost, control of the deposited layer thickness, control of deposition rate, working at room temperature and normal pressure. Metal matrix composite coatings are composed of a metal matrix containing particles with different size and nature. Incorporation of the nanoparticles into a metallic matrix leads to the development of composite with enhanced mechanical and corrosion properties. Only homogeneous dispersion of the particles leads to improvement of metal matrix properties [1-4]. Nano ceria particles are able to polarize cathodic reactions and thereby decrease oxidation rate of the substrate. The aim of this work was to obtain and characterize novel Zn-Co-CeO₂ nanocomposite coatings.

Electrodeposition was performed galvanostatically with different current densities. As a source of the particles in the plating solution, ceria powder and synthesized ceria sol were used and compared. A comparison of the effects of mechanical and ultrasound stirring on the properties of the Zn-Co-CeO₂ composite coatings were also studied. Two different vibration amplitudes of the ultrasound horn were applied, 25% and 55%, corresponding to 20 and 40 W cm⁻² power, respectively. Surface of the coatings, as well as cross section, were examined by Scanning Electron Microscopy. Chemical composition was determined by EDAX coupled with FE-SEM.

The homogenous distribution of Ce particles, Zn and Co in the coatings was confirmed by mapping. Mechanical stirring of the plating solution during electrodeposition resulted in formation of the irregular, porous coatings structure. Utilizing the ultrasound agitation promoted formation of more compact and crack free composite coatings with better adhesion to steel substrate. However, the increase of the US intensity did not result in significant changes of obtained composite coatings. Scanning Kelvin Probe measurements were used to clarify the role of the ceria nanoparticles in the system reactivity. The corrosion behavior was analyzed during exposure to 3 wt.% NaCl solution by electrochemical impedance spectroscopy and polarization measurements. The good corrosion stability of composite coatings was probably due to the self-healing effect.

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Keywords: nanocomposite coating, electrodeposition, ultrasound agitation.

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9-6

Nano/microcontainers for corrosion protection of a copper/gold galvanic couple

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The current demand for miniaturized electronic devices has resulted in higher density packing with reduction in component size, closer spacing, and thinner metallic parts and the close packing of different metallic materials (including copper and gold) can lead to the eventual appearance of corrosion phenomena, especially galvanic corrosion. Thus, it's uttermost necessary to address the issue of copper/gold galvanic corrosion and to develop corrosion protection strategies to mitigate this problem. [1-3]

Representative galvanic cells, made of the selected metals (copper and gold) used in portable electronic devices were made as simplified models of real components. The study of three different corrosion inhibitors (benzotriazole - BTA, cerium nitrate, cysteine and also combinations between them) was carried out using electrochemical techniques to understand the electrochemical behaviour and corrosion mechanism of the galvanic couple. Electrochemical impedance spectroscopy (EIS) was employed to evaluate the active protection. Further electrochemical characterization was achieved by scanning vibrating electrode technique (SVET), d.c. polarization curves and linear polarization resistance (LPR). After different immersion times, the samples were analysed by visual inspection and scanning electronic microscopy (SEM).

Silica containers were prepared in order to encapsulate the selected corrosion inhibitors. Inhibitor loading was achieved by different loading methods (both during and after container synthesis). The containers were characterized by physicochemical and spectroscopic techniques to access its morphology and encapsulation efficiency to select the most promising systems for inclusion in protective sol-gel coatings.

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9-7

Phase composition of technologically-modified MgAl₂O₄ nanoceramics

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It is well-known that humidity-sensitivity MgO-Al₂O₃ ceramics is determined primarily microstructure of grains, grain boundaries and pores, which can be changed by controllable optimization process. To experimental diagnostics of phase compositions of such materials well-known methods such as X-ray diffractometry (XRD) are used. But alternative methods are also needed to interpretation parameters of main and additional phases in nanostructured materials. In this work the phase composition of the technologically-modified MgO-Al₂O₃ ceramics were investigated using combined XRD and high-resolution X-ray photoelectron spectroscopy (XPS) methods.

The investigated MgO-Al₂O₃ ceramics were obtained from MgO and Al₂O₃ powders using special time-temperature regimes with maximal sintering temperature T_s of 1200 °C and 1400 °C at 2 h and 9 h. The XRD results were obtained at room temperature using HZG-4a diffractometer (CuK α radiation). The parameters of crystal structure of the main and addition phases were calculated using FULLPROF.2k program. The XPS investigations were carried out using Scienta ESCA-300 spectrometer (Al K α X-rays with energy of 1486.6 eV) [18]. Standard ESCA-300 software was applied to analysis of XPS data. Concentration of elements was funded from area of corresponding core-level peaks. The full width at half maximum (FWHM) was determined for each peaks. The err-bars for peak position and area were 0.05 eV and 2 %, correspondingly.

It is shown that structural perfection of MgO-Al₂O₃ ceramics increases with sintering temperature and their duration, which manifests reducing the content of the additional phases. Modification of ceramics obtained at 1400 °C by increasing the sintering duration leads to increase of MgO phase. The core-level O 1s spectrum in MgO-Al₂O₃ ceramics allows identifying the chemical state of atoms and makes it possible to obtain confirmation about addition phases in ceramics.

10-1

**Effects of electron acceptors and radical scavengers on the kinetics
of photodegradation of ceftriaxone under simulated solar irradiation**

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Recently, antibiotics have been extensively applied in various industries including agricultural, pharmaceutical and veterinary. Great concerns of antibiotics are about discharge into environment, especially water sources. Ceftriaxone is a third-generation cephalosporin antibiotic with a broad antibacterial spectrum that has an established clinical efficacy and high tolerance with a potent antimicrobial activity. These facts contribute to the broad application of ceftriaxone. In this study effect of electron acceptors (H_2O_2 , KBrO_3 , and $(\text{NH}_4)_2\text{S}_2\text{O}_8$) and radical scavengers (methanol, ethanol, and NaI) on photodegradation efficiency of ceftriaxone in the presence of ZnO catalyst under simulated solar irradiation were studied. The obtained results were compared to the results in the presence of electron acceptors and radical scavengers in the absence of ZnO catalyst and to the results of direct photolysis. The kinetics of degradation was monitored by ultra fast high performance liquid chromatography with diode array detector.

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10-2

Structural, morphological and optical characteristics of ZnO particles synthesized in the presence of surfactants CTAB and Pluronic F-127

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Due to its optical and electrical properties, low toxicity, chemical and physical stability, as well as inexpensiveness, zinc oxide (ZnO) based materials have a great potential to be used as photoelectrode in photo(electro)catalysis. Photo(electro)catalytic activity of ZnO materials can be improved by modification of particles morphology and surface topology.

In this work, the influence of two different surfactants: cetyltrimethylammonium bromide (CTAB) and Pluronic F-127, on the crystal structure, morphology, optical and photo(electro)catalytic properties of ZnO particles, were examined. ZnO powders were synthesized by microwave processing of a precipitate which was previously prepared by "drop by drop" method in the presence of the surfactants. The crystal structure and phase purity of the ZnO particles were determined by X-ray diffraction and Raman spectroscopy. The effects of the surfactants on ZnO particles morphology were examined by the field emission scanning electron microscopy (FE-SEM). The optical properties were studied using UV-Vis diffuse reflectance and photoluminescence spectroscopy. Photocatalytic activity was examined *via* decolorization of methylene blue under direct sunlight irradiation. It was found that synthesized ZnO powders have a significant photocatalytic activity. Electrochemical properties were studied using linear sweep voltammetry and impedance spectroscopy in Na₂SO₄ electrolyte. ZnO powder synthesized in the presence of CTAB (ZnO/CTAB) showed the most significant reduction of potential and the fastest kinetic of oxygen evolution.

10-3

TiO₂/Ag nanoparticles modified cotton fabric and its application to photocatalysis

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In a series of researches so far, it has been shown that TiO₂ nanoparticles have become the focus of intensive exploration in the field of photocatalysis, as a consequence of their unique properties and potential applications. In order to improve photocatalytic and functional properties of TiO₂ nanoparticles, different methods should be used. One of the most effective approaches is capping of noble metal (Pt, Ag, Au) clusters on nanoparticle surface. Namely, metal clusters act as electron traps and they promote interfacial charge-transfer processes and reduce undesirable recombination processes on TiO₂ nanoparticle surface. As a consequence, photocatalytic efficiency of the system should be improved.

The cotton fabric modified by TiO₂/Ag nanoparticles was synthesized by *in situ* photoreduction of Ag⁺-ions on alanine modified TiO₂ colloidal nanoparticles previously deposited onto cotton fabric. Adsorption of Ag⁺-ions on TiO₂ nanoparticle surface was improved by addition of alanine amino-acid. As a result, separation of photoinduced charges is preferred and recombination process is significantly reduced. In order to further improve the efficiency of the system, methyl alcohol was employed as hole-scavenger.

Obtained results confirmed the presence of TiO₂/Ag nanoparticles across the surface of cotton fabric (SEM), as well as successful fabrication of metallic Ag on investigated fabric (XRD). Interaction between alanine modified TiO₂ and Ag nanoparticles was studied by FTIR, while structural properties of synthesized samples were investigated by Raman spectroscopy. The photocatalytic performance of TiO₂/Ag nanoparticles modified cotton fabric was tested in the process of photodegradation of organic dyes under simulated solar light: Rhodamine B, Acid Orange 7 and Methyl Red.

10-4

Surface optical phonon – Plasmon interaction in nanodimensional CdTe thin films

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Structural and optical properties of CdTe thin films were investigated applying atomic force microscopy (AFM), XRD powder technique, Raman spectroscopy and Far–infrared spectroscopy. CdTe thin films were prepared by using thermal evaporation technique. In the analysis of the Far – infrared reflection spectra, numerical model for calculating the reflectivity coefficient for system which includes films and substrate has been applied. Effective permittivity of film mixture (CdTe and air) was modeled by Maxwell – Garnet approximation. We reveal existence of surface optical phonon (SOP) mode and Plasmon-phonon interaction, associated with it.

10-5

***In vitro* testing of genotoxic and apoptotic potential
of two synthesized nanomaterials by DNA fragmentation assay**

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Nanomaterials represent a relatively new and developing class of materials that are widely used because of their unique mechanical and physiochemical properties. Due to the particles' size and the ability to easily enter the cells and interact with different cellular components, nanoparticles can exhibit toxic effects in biological systems, so it is necessary to conduct a thorough *in vitro* biocompatibility testing. Our aim was to examine the *in vitro* genotoxic and apoptotic potential of two different synthesized nanomaterials intended for bone tissue engineering and regenerative applications: biphasic calcium phosphate coated with poly-D,L-lactide-co-glycolide (CP/PLGA) and cobalt-substituted hydroxyapatite (CoHAp), by DNA fragmentation assay. NB4 cells (acute promyelocytic leukemia cell line) were incubated with different concentrations of CP/PLGA and CoHAp nanomaterials for 24 hours. Cells cultured in standard medium, without nanomaterials, were used as negative control and cells treated with hydrogen peroxide were used as positive control. After incubation with materials the genomic DNA was extracted from the cells and applied on horizontal agarose gel electrophoresis. The results of DNA fragmentation assay were observed on gel documentation system. Higher examined concentrations of CP/PLGA caused DNA fragmentation at some extent with DNA laddering at approximately 180 bp which is characteristic for later stages of apoptosis, while DNA laddering was not seen in the case of CoHAp at the same concentrations. Although both materials are in the form of nanoparticles, a different effect in apoptotic DNA fragmentation was observed which suggests that the chemical composition of nanomaterials notably affects the genotoxicity and apoptosis potential in addition to the particle size.

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10-6

Raman Spectroscopy Study on phase transition in CrI₃ single crystals

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By virtue of their unique properties and the potential for a wide spectrum of applications, such as the development of functional van der Waals heterostructures, CrI₃ among the other two dimensional materials, has received significant attention in the most recent studies on the ferromagnetic semiconductors. In this study we represent the vibrational properties of CrI₃ single crystals investigated using Raman spectroscopy together with the density functional theory (DFT) calculations. Experimental results show that first-order phase transition from the low-temperature ($R\bar{3}$) to the high-temperature ($C2/m$) phase occurs at 180K with no evidence of the two-phase coexistence. All observed modes, in both phases, are in good agreement with DFT calculations.

11-1

Influence of Ho doping on magnetic properties of bismuth ferrite nanopowders

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Bismuth ferrite (BiFeO₃) is one of the most studied multiferroic systems mainly because of BiFeO₃ material possesses both antiferromagnetic and ferroelectric properties observed at room temperature, which opens great possibilities for industrial and technological application. The influence of Ho doping on the crystal structure and magnetic properties of bismuth ferrite (BFO) nanopowders was investigated. BiFeO₃ and Bi_{1-x}Ho_xFeO₃ ultrafine nanopowders were synthesized by the hydrothermal method. Here we use simple, low-cost and energy-saving hydrothermal method, which has advantages over the conventional methods. The diffraction pattern was recorded at room temperature and atmospheric pressure in the absence of any re-heating of the sample. A fitting refinement procedure using the Rietveld method was performed which showed the incorporation of Ho³⁺ ions in the BiFeO₃ crystal lattice, where they substitute Bi³⁺ ions. All the samples belong to R3c space group. Magnetic behavior of synthesized materials was investigated by SQUID magnetometer in wide temperature interval (2-800 K). Temperature dependence of magnetization shows antiferromagnetic transition at T_N ~ 630 K and below this temperature weak ferromagnetism is observed, which becomes enhanced with the Ho-doping.

11-2

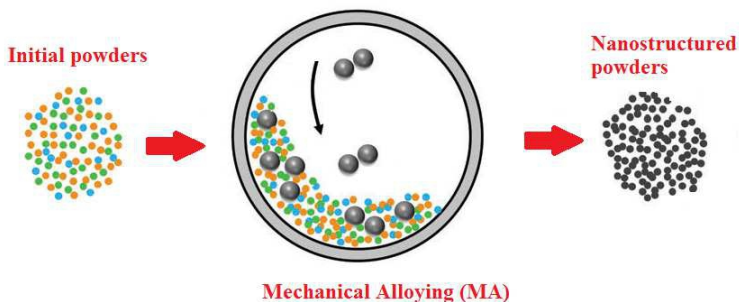
Microstructural changes of $(\text{Ti}_{1-x}\text{M}_x)\text{C}$ (M=Cr and W) solid solutions induced by mechanical alloying

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Nanostructured (Ti, Cr, W)C solid solutions were successfully synthesized by mechanical alloying (MA) from the mixture of titanium, chromium and graphite (carbide 1), and titanium, tungsten and graphite (carbide 2) under argon atmosphere. MA was carried out in a high energy planetary ball mill Fritsch Pulverisette, at room temperature. Microstructure changes, such as crystallite size, micro-strains were determined from the Rietveld refinement of the X-ray diffraction patterns. Scanning electron microscopy (SEM) was employed to examine the morphology of the samples as a function of milling times. Transmission electron microscopy (TEM) was used to measure nanoparticles size of the samples. However, the morphological and microstructural investigations indicate that Ti, W and Cr were homogeneously distributed in the solid solution powders. X-ray diffraction results show the nano-scale single-phase solid solution could be prepared with a short time of milling. In addition, the obtained solid solution powders were also used in the preparation of (Ti, M)(C, N)-based cermets to show its high potential in future application as cutting tools.

Keywords: Mechanical alloying (MA); Microstructure; X-ray diffraction; Nanostructure; Carbide.



Schematic diagram illustrating mechanical alloying process

11-3

Macro and micro wettability of hydrophobic rough surface

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Hydrophobic siloxane films filled with microparticles on non- and plasma activated glass substrates were synthesised by sol-gel dip-coating method using TEOS-HS precursor compositions followed by exposure in HMDS (hexamethyldisilazane) vapour at ambient temperature. The precursor compositions were prepared by TEOS ($\text{Si}(\text{OC}_2\text{H}_5)_4$) acidic hydrolysis and filling with HS microparticles (Hi-Sil-T700 silica particles of 4 μm from PPG Silica Products). TEOS was preliminary hydrolysed for 2 hours (the reactant molar ratio was 1.0 $\text{Si}(\text{OC}_2\text{H}_5)_4$: 0.05 HCl : 3.82 H_2O) and diluted with HS suspension in $\text{C}_2\text{H}_5\text{OH}$ in the proportion 1:3 per volume followed by stirring for 30 min. The precursor compositions with HS loading of 0.9, 1.8 and 2.7 mol/L were used for the film synthesis.

Water advancing and receding contact angles were measurement by tilted plate method. The apparent surface free energy of these surfaces was evaluated using the hysteresis approach. Topography of the surfaces was examined with help of optical microscopy and optical profilometry.

The highest value of water contact angles are obtained for glass support pretreated by air plasma and for most hydrophobic silica it was $153^\circ \pm 0.3$, for samples obtained on argon plasma activated glass advancing contact angle was $152.6^\circ \pm 1.2$ and for sample obtained using untreated glass was $146.7^\circ \pm 2.3$.

The apparent surface free energy calculated from the hysteresis approach for most hydrophobic sample was $3.4 \pm 0.6 \text{ mJ/m}^2$. For all samples contact angle hysteresis was less than 10° and the sliding angle was about 10° . Taking into account the obtained data superhydrophobic properties were obtained on tested surfaces.

11-4

**Spectrophotometric and thermal properties of poly(vinyl butyral)
and epoxy protective coatings with nanostructures of WS₂**

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PVB is a flexible but tough polymer of excellent optical clarity and transparency, and due to that it has a wide application in different coatings and in laminated glass industry. Epoxy resin has good mechanical resistance and it is also applied in coatings, but also as a binder in composites. In this research a possibility was examined to improve thermal resistance and spectrophotometric properties of thin film coatings of PVB and epoxy modified with addition of 10 wt.% of PVB, by addition of small concentrations of tungsten disulfide nanotubes and nanoparticles.

Coatings were applied on glass plates by solvent-casting technique: PVB and epoxy/PVB were dissolved in ethanol in which previously nanostructures were deagglomerated and dispersed using ultrasonic probe. Inorganic fullerene-like nanoparticles of tungsten disulphide (IF-WS₂) were added in concentration 1 wt.% and nanotubes (INT-WS₂) in concentration 0.3 wt.%.

Dispersion of tungsten disulfide nanostructures was observed using scanning electron microscope. Thermal resistance was examined by differential scanning calorimetry. The following spectrophotometric properties were examined: diffuse reflection and transmission, using spectrophotometer Shimadzu UV 3600 with an integrating sphere and UV Probe programme package, and specular gloss, using glossmeter Elcometer 480, under angles 20°, 60° and 85°. Observed results have indicated that new composite coatings with nanostructures have enhanced thermal resistance and camouflage properties for potential military applications.

Keywords: thin film coatings, poly(vinyl butyral), tungsten disulfide, nanostructures, thermal resistance, spectrophotometric properties.

11-5

**Unstable plastic deformation of ultrafine-grained magnesium alloy AZ31
at low temperature**

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Magnesium alloys, due to their properties, are interesting for various technological applications, including aerospace engineering. To execute the drawing and stamping of magnesium alloys, mainly, at elevated temperatures. Severe plastic deformation (SPD) methods are used to improve the strength and ductility of magnesium alloys at lower temperature. One of the SPD methods for the production of bulk ultrafine grains (UFG) and nanostructured metals and alloys has been equal-channel angular pressing (ECAP). As a result of ECAP, the grains are pounded, the dislocation density and the crystallographic texture are changed. In this work, polycrystals of the AZ31 magnesium alloy (Mg-2.7 at.% Al-0.4 at.% Zn) were investigated with two microstructure types A and B. The structure A to arise from the extrusion and 8 pass ECAP. The structure B to arise from the 4 hours annealing the structure A at 300 °C. The average grain size d_A and the average dislocation density ρ_A for A are 0.8 μm and 10^{14} m^{-2} , respectively. In the A structure is formed a crystallographic texture when the basal planes are oriented at $\sim 45^\circ$ to the ECAP direction. For the B structure, the average grain size d_B and average dislocation density ρ_B are 3 μm and $\sim 10^{12} \text{ m}^{-2}$, respectively.

At temperature lower of 4.2 K the plastic deformation of AZ31 becomes discontinuous. The character of so-called low-temperature jump-like deformation (LTJD) depends on the microstructure and temperature. The local shear of the crystal lattice, which in the experiment causes macroscopic stress relaxation in the form of a jump $\Delta\sigma$, is associated by collective (avalanche-like) displacement of several tens of dislocations accumulated near a strong obstacle, for example, sessile dislocation. The concentration of sessile dislocations increases with strain and is proportional to the total dislocation density. At high dislocation density (at a critical threshold strain), the collapse of one of the strong barriers may contribute to the collapse of the neighboring, i.e. the dislocation motion acquires a catastrophic (avalanche-like) character, when the rate of plastic deformation significantly exceeds the elongation rate determined by moving rod. The scale of this collapse is proportional to the separate jump amplitude $\Delta\sigma$. This model can explain with our experimental data taking into account the higher initial dislocation density in sample A as compared to B. The density of grain boundaries as another factor limiting the dislocation avalanches can be responsible for comparatively low fraction of small jumps in the case of fine-grained sample A.

11-6

Optical detection of ultra-trace level of aqueous uranyl ions by magnetically functionalized cadmium sulphide quantum dots fluoroprobe

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Optical detection of trace level of aqueous uranyl ions without using complicated instrumentation is a challenge for environmental monitoring and remediation. In this project we report an ultra-trace level optical sensing of uranyl ions using functionalised fluorescent Cadmium Sulphide Quantum Dots (CdS QDs) immobilised on Iron Oxide Nanoparticles (IONPs). Thiourea functionalised CdS QDs exhibits steady fluorescence quenching in the presence of aqueous uranyl ions. The striking feature of using magnetic nanoparticles with functionalised CdS QDs is to employ the sensing methodology along with magnetic separation of fluoroprobe in the presence of external magnetic field. The characteristic Stern-Volmer plot of fluorescence quenching studies represents the dynamic quenching behaviour of the magnetic fluoroprobe. Elevated concentrations of uranyl ions were recognised after specific complex formation with Arsenazo (III) dye. Limit of Detection (LoD) calculated in this method was in the range of $\mu\text{g/L}$. Very easy and simple method employed here should facilitate to extend a reliable optical sensor in order to detect ultra trace level of uranyl ion in drinking water.

12-1

Customizing nanotubular titania for photocatalytic activity

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Semiconductor TiO₂ photocatalysis is a heterogeneous catalysis, where the photons of the sun or artificial light source are activating the catalyst that enters in reactions. The targeted real-world applications are in environmental protection and remediation such as wastewater treatment, air purification and decomposition of harmful organic pollutants. In this talk, I present the synthesis of nanotubular, thin TiO₂ coatings with altered morphology and crystallinity made by anodization technique. The influence of the anodization parameters and post-synthesis annealing conditions on the photocatalytic methyl orange dye decomposition was assessed. Different morphology, crystallinity and introducing a dopant into lattice increase electron transport and electron lifetime which further improve photocatalytic activity.

12-2

Synthesis and characterisation of ZnO synthesized by glycine-nitrate combustion process

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One of the ways to get rid of toxic organic compounds that industries release into natural waters is photocatalysis of the decomposition of organic compounds on the surface of heterogeneous photocatalysts such as zinc oxide. Zinc oxide is a semiconductor that interacts with UV and near-UV visible light by generating electron-hole pairs which decompose organic molecules. Therefore it is useful to explore different ways of synthesizing zinc oxide and to test quality and quantity of organic decomposition photocatalysis so as to enable the commercial use of the material. Zinc oxide is also a respectable material for use as a photoelectrocatalyst in water oxidation, for example, which can be useful for generating oxygen while using natural sunlight - a clean and abundant energy source.

In this project nanocrystalline zinc oxide was synthesized by glycin-nitrate combustion process and the powder was annealed on temperatures of 400 °C and 500 °C.

Obtained particles were characterized in detail using X-ray powder diffraction (XRPD), Fourier-transform infrared spectroscopy (FTIR), Raman spectroscopy, field emission scanning microscopy (FESEM), photoluminescence spectroscopy (PL) and diffuse reflectance spectroscopy (DRS). The results show that obtained samples are nanocrystalline wurtzite zinc oxide, with particle diameters of 33 nm (annealed at 400 °C) and 48 nm (annealed at 500 °C). Both samples show significant amount of various crystal defects. Zinc oxide band gap of the samples are determined to be lower than the band gap of the bulk zinc oxide.

Photoelectrocatalytic properties were investigated via electrochemical methods: linear voltammetry (LV), chronoamperometry (CA) and impedance spectroscopy (EIS). The results show that material is photostable and reactive to the light. Water oxidation is enhanced by exposing to sunlight.

Finally, photocatalytic properties are tested with determining kinetic parameters of phenole and methyl blue decomposition. Zinc oxide nanoparticles are efficient photocatalysts, although sample annealed at 500 °C shows better properties than sample annealed at 400 °C.

12-3

Kinetics and modeling of sorption behavior of chitosan-based hydrogel

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The wastewater from textile industry is a challenge to the science since it can cause serious problems in environment and ecosystem such as toxic, carcinogenic, mutagenic, and teratogenic effects. For that reason, chitosan has been widely used in sorption processes for different organic substances (fats, pigments, dyes, and heavy metal ions). In this study, chitosan-based hydrogel was applied to sorb two textile dyes: C.I. Acid Orange 7 and C.I. Basic Red 1 and modeling of sorption process was made. All sorption experiments were performed from simulated textile wastewater which contained washing powder or liquid detergent which are frequently used in textile industry, salts, polymers, bases, and acids. The experiment was set up under optimal pH condition for each dye to obtain equilibrium data at 25 °C and 50 °C from 1 h to 24 h. It was found that higher sorption efficiency was achieved at 25 °C during 24 h. The models used to describe the kinetics of dye sorption are pseudo-first and pseudo-second order, Weber and Morris intraparticle diffusion model, and Elovich model. The results indicate that, depending on the type of used dye, detergent, and temperature, different model describes better sorption process.

12-4

The application of calcined clay materials from waste mine overburden as cement substitution

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Cement manufacturing is a major source of greenhouse gases and it causes more than 5 percent of CO₂ production. Few studies tried to solve the emission production by the cement industry concentrating on intervention of the other affordable and attainable materials such as clay. In fact, an ordinary way to reduce the CO₂ emission attributed to cement production is to substitute a large portion of clinker in cement to create blended cements, or replace an OPC in concrete mixture with proper supplementary cementing materials (SCM). Supplementary cementing materials have become an integral part of high strength and high performance concrete mix design. These may be naturally occurring materials, industrial wastes, or byproducts or the ones requiring less energy to manufacture. Some of the commonly used supplementary cementing materials are fly ash, silica fume (SF), granulated blast furnace slag (GGBS), rice husk ash (RHA) and metakaolin (MK), etc. Metakaolin is obtained by the calcination of kaolinite. It is being used very commonly as pozzolanic material in mortar and concrete, and has exhibited considerable influence in enhancing the mechanical and durability properties of mortar and concrete. In this research, the waste mine overburden is evaluated as a potential substitute for cement. Two type of clayey mine waste (M1 and M2) is considered to employ as calcined clay for Calcined Clay Cement (C3) compared with Meta-Kaolinite and cement paste. To evaluate the raw materials, several types of analyses have been performed. First, the potential reactivity of normal clays is analyzed by the thermo-gravimetry method to identify the optimum dehydroxylation temperature. Then, the phase analysis has done by means of X-ray diffractometer (XRD) while the scanning electron microscopy (SEM) photos elaborate phases present in the raw material. Another method which is used to evaluate the pozzolanic activity is based on the measurement of compensated electrical conductivity of calcium hydroxide saturated solution, to which the material is added over time. The whole materials are calcined and used as 30% of cement substitute in calcined clay cement paste samples for the best indicator which is compressive strength test. M1, M2 and Kaolinite samples were evaluated by compression strength test through the 2, 7, 28, 50 and 90 days of setting time. Results represents the applicability of waste mine overburden materials as the proper substitution for cement while there is no need to process this materials.

Keywords: Calcined Clay Cement, Mine Waste Overburden Clay, Pozzolanic Reactivity, Pozzolanicity.

12-5

Electrochemical behaviour of carbon steel C15 in the presence of aloe vera gel

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The electrochemical behaviour of carbon steel C15 was investigated in 0.1 mol/dm³ H₂SO₄ containing *Aloe vera Barbadosensis Miller* gel (1-3 mL A.v.g. in 100 cm³ of 0.1 mol/dm³ H₂SO₄). Experimental research, performed without and in the presence of aloe vera gel, was done using measurement of open circuit potential, cyclic voltammetry and potentiostatic method. Characterization of electrode surface after potentiostatic treatment was performed by optical microscopy. The open circuit potential of steel C15 moves towards more positive values with the increase of *Aloe vera Barbadosensis Miller* gel volume. Value of the open circuit potential is most positive with the addition of 3 mL A.v.g. . Two current peaks appear in the anodic part of the voltammogram obtained for steel in 0.1 mol/dm³ H₂SO₄. With the increase of added gel, the current density values are decreasing, the anodic current peaks appear on a more positive potential in relation to the results obtained without the gel addition and the second current peak is almost imperceptible. The results obtained by the cyclic voltammetry method indicate that the aloe vera gel acts as an anodic type inhibitor of steel corrosion in 0.1 mol/dm³ H₂SO₄. Potentiostatic investigations were performed at a potential of 0 V vs. SCE for 100 s, in the presence and in the absence of aloe vera gel. The results showed that stabilization was achieved faster in the presence of the aloe vera gel. Also, with an increase of the inhibitor amount the stationary current density is being decreased. Micrographs of the electrode surface confirmed that the damages were less expressive in the presence of aloe vera gel. According to the results it can be concluded that examined substance slows the oxidation processes on the surface of steel C15 in a certain range.

12-6

Sorption of Pb²⁺ ions from wastewater by Paulownia leaves and their hydrochar

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It is of great importance to treat wastewaters, which contain heavy metals in concentrations harmful to the environment, before their discharge into watercourses. The biosorption is powerful tool for the removal of heavy metals from wastewaters. Paulownia leaves become biowaste during wood processing in industry and represent possible biosorbent or source for production of efficient adsorbents. In this study, Paulownia leaves and Paulownia leaves hydrochar produced at 180 °C were used as adsorbents of Pb²⁺ ions and their efficiency was determined. Paulownia leaves and hydrochar, before and after adsorption of Pb²⁺ ions, were characterized by FTIR spectroscopy. It was observed that oxygen functional groups might be crucial for adsorption of Pb²⁺ ions. The preliminary adsorption test showed that leaves without structural changes had better adsorption capacity which was q=34.53 mg/g than hydrochar produced at 180°C, q=10.57 mg/g. Therefore, Paulownia leaves could be considered as efficient adsorbent for Pb²⁺ removal.

13-1

Adsorption study of cadmium ions on modified kaolinite by some amino acids

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Continuous development of new technologies leads to increasing pollution of water, thus creating the need for new materials that could be used in the processes of their purification. Therefore, adsorbents prepared from agricultural waste, resins, silica gels, zeolites, clays, flying ash, aluminosilicates and other materials are being investigated as potential sorbents. Recently research has focused on improving the adsorption capacity by modifying the material by binding or impregnating inorganic and organic molecules on the surface. In this paper, the kaolinite modification with amino acids, histidine and cysteine, was performed to improve the efficiency of adsorption of heavy metal ions (Cd, Pb, Zn). Weighed sample of kaolinite was immersed in 0.1 mol/dm³ solution of amino acid (histidine or cysteine) and stirred for 24 hours. The precipitate was washed and dried at a temperature of 110 °C, to remove excess water. Cation exchange capacity (CEC) of raw and modified kaolin was determined by titration with methylene blue. The influence of operating parameters such as adsorption time, pH value of the solution, initial metal concentration and temperature on the capacity and adsorption efficiency were examined. Better agreement of experimental results with Freundlich's adsorption isotherm and the pseudo-second order kinetics model suggest that the adsorption of cadmium ions on the investigated adsorbents takes place with the chemisorption mechanism. The change of Gibbs free energy has a negative value for both adsorbents, which shows that the adsorption process is spontaneous. By comparing the achieved results for raw and modified kaolin, it can be concluded that histidine-modified kaolin can be successfully used for adsorption of heavy metal ions from aqueous solutions.

13-2

Optimization of biocomposite composition for efficient adsorption of nickel (II) ions

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Easily accessible and waste materials are materials that are increasingly explored for use in biosorption in order to reduce environmental pollution. Among many pollutants, heavy metals represent a particularly dangerous group due to bioaccumulation and nondegradability. Nickel ions represent special danger due to the relatively high presence and low biosorption affinity. Therefore, the development of a cheap and effective removal method would represent a significant shift in the removal of these ions. Among biosorbents with the highest potential for application in the removal of heavy metal ions are biopolymers. Short and intricate hemp fibers, which are waste in the textile industry, are a cheap lignocellulosic biosorbent for efficient removal of heavy metals from aqueous solutions. Alginates also represent high-efficient natural biosorbents. Biocomposite of hemp fiber and alginate could improve mechanical and adsorption properties in relation to individual components. This work is aimed to determine the optimum ratio of alginate and hemp fiber to achieve the highest adsorption capacity of nickel ions and better kinetics of the process. Atomic Adsorption Spectrophotometry (AAS) was used to measure the concentration of nickel. The results of the experiments were compared with Langmuir, Freundlich and Sips adsorption isotherms, and the adsorption kinetics were compared with the pseudo-first, pseudo-second order and Weber-Morris model. The obtained results indicate the optimal method for the preparation of biosorbent, give its adsorption capacity and the kinetics of the process itself. Based on the obtained results, it can be concluded that adsorption processes depend on operating parameters in the following way: the adsorption capacity and the efficiency of nickel removal is the highest in hemp fibers once immersed in the alginate solution. The increase in the mass of the alginate in the composite for the second immersion of the hemp fibers prolonged the reach of the maximum adsorption, thereby reducing the rate of removing nickel ions from the solution.

13-3

**Assessment of the applicability of raw and calcined seashells
for the treatment of industrial wastewater**

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Limestone and lime are common chemical agents used for pH adjustment and removal of toxic metal ions from wastewater, especially when it comes to effluents with high metal concentrations (>1000 mg/L). Due to high content of calcium carbonate, seashell waste could replace the natural limestone, in support of sustainable resource and waste management. In this study, raw and calcined seashells were used to treat the industrial wastewater collected at the Mining and smelting complex (Bor, Serbia), characterized by low pH (1.6) and elevated concentrations of Cu (613.2 mg/L), Zn (270.1 mg/L), Fe (104.0 mg/L), Ni (4.40 mg/L) and Pb (4.34 mg/L). The two level full factorial design was used to evaluate the significance of seashell composition (calcium carbonate and calcium oxide), particle size, dose and reaction time, as independent process variables. Statistical analysis of the data was performed by MINITAB software, using the residual metal concentrations and final pH values as measured system responses. The magnitude, direction and statistical significance ($\alpha=0.05$) of the effects caused by variation of selected factors, were evaluated by main effect, normal probability, interaction and contour plots. The seashell dose and granulation, as well as their interaction, were the most influential factors in terms of metal removal efficiency, while the variation of the reaction time was the least significant. Investigated factors had a considerable effect on the process through the indirect effect onto the solution pH. More than 99% of Cu ions were separated at pH >7, while the final pH range 8.2-12.2 was found optimal for the separation of all metals (97.6 - 98.9 %). Removal of more than 95% of all metal cations can be reached using fine granulation and high doses of raw seashells, whereas addition of calcined seashells can provide the same results in a range of granulation/dose combinations.

13-4

Iron-impregnated paper mill sludge as Fenton process catalyst

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The aim of this study was investigation of application possibilities for iron-impregnated waste material - paper mill sludge (PMS) in the decolourization process of Brilliant Blue R (BBR) textile dye. The chosen treatment was a heterogeneous Fenton process, where iron species are used as a catalyst of reaction with hydrogen peroxide, thus producing highly reactive hydroxyl radicals. The simple impregnation method was employed for modification of raw PMS, in that way developing catalyst with 7 molar ratios (0.6, 1.3, 3, 5, 7, 9 and 11 mmol Fe³⁺/g). All of them were calcinated at two different temperatures, 350 and 550°C. Beside dye oxidation process, the characterization of raw and modified PMS was also conducted. Namely, surface area analysis (BET) and scanning electron microscopy (SEM) with energy dispersive X-ray spectrometry (EDS) were used, whose results indicate that there is a significant change in specific surface area (from 1 to 59 m²/g), surface appearance and iron content (from 0.84 to ~70%). The efficiency of Fenton process was high, up to 88.2 and 86.5% after 180 min, for both calcination temperatures respectively, while catalyst stability was disturbed when applying higher temperature (iron leaching varied from 0.14 to 1.59 mg/l for PMS-550). Therefore, for the effective application of iron-impregnated PMS in the heterogeneous Fenton process of textile dye decolourization, molar ratio of 3 mmol Fe³⁺/g calcinated at 350°C is favored, due to oxidation performance and achieved stability.

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13-5

Influence of the type of polyacrylamide ionic group on the accumulation of chromium(VI) ions in the montmorillonite-aqueous solution system

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Erosion, which is a global problem, is the process of soil environment degradation caused by factors such as wind or water. This leads to destruction of its structure, nutrients removal and finally bedrock exposition and desertification. One of the ways to prevent this phenomenon is soil conditioners usage. These substances, also called soil flocculants, are macromolecular compounds which contribute to the reinforcement of soil structure as a result of its adsorption on mineral surface. Due to formation of polymer bridges between loose particles larger aggregates are formed in the process of flocculation. This leads to an increase of cohesion and soil stability improvement. Moreover, addition of flocculant provides leaching resistance and improves water infiltration into soil which is very desirable. Most of soil conditioners used in agriculture consist of polyacrylamide or poly(acrylic acid). These macromolecular substances affect soil surface properties and behaviour of substances present in the environment – nutrients, organic molecules but also hazardous compounds and toxic heavy metals (i.e. chromium(VI) ions). The aim of this study was to investigate the impact of solution pH, type of ionic group in the polyacrylamide macromolecules and chromium(VI) ion concentration on the heavy metal and polymer adsorption on the montmorillonite surface.

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