Serbian Ceramic Society Conference
ADVANCED CERAMICS AND APPLICATION X
New Frontiers in Multifunctional Material Science and Processing

Serbian Ceramic Society
Institute of Technical Sciences of SASA
Institute for Testing of Materials
Institute of Chemistry Technology and Metallurgy
Institute for Technology of Nuclear and Other Raw Mineral Materials

PROGRAM AND THE BOOK OF ABSTRACTS

Serbian Academy of Sciences and Arts, Knez Mihailova 35
Serbia, Belgrade, 26-27. September 2022.

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Dear colleagues and friends,

We have great pleasure to welcome you to the Advanced Ceramic and Application X Conference organized by the Serbian Ceramic Society in cooperation with the Institute of Technical Sciences of SASA, Institute of Chemistry Technology and Metallurgy, Institute for Technology of Nuclear and Other Raw Mineral Materials and Institute for Testing of Materials. This Conference is dedicated to Prof. Dr. Vojislav Mitić, president of Serbian ceramic society, who passed away in September 2021.

It is nice to host you here in Belgrade in person. As you probably know, Serbia launched a vaccination campaign at the beginning of last year, so up to date more than 70 percent of the adult population has been vaccinated. Since there is no one statistic to compare the COVID19 outbreaks and fears for loved ones in different countries, we believe that we all suffer similarly during this pandemic. That is why we appreciate even more your positive attitude and readiness to travel in this uncertain time. We deeply hope that the ACA X Conference will be worth remembering, that you will respect all COVID-19 safety measures at SASA building, that you will have a nice time here and that ultimately you will return to your home safely. We are very proud that we succeeded in bringing the scientific community together again and fostering the networking and social interactions around an interesting program on emerging advanced ceramic topics. The chosen topics cover contributions from fundamental theoretical research in advanced ceramics, computer-aided design and modeling of new ceramics products, manufacturing of nano-ceramic devices, developing of multifunctional ceramic processing routes, etc.

Traditionally, ACA Conferences gather leading researchers, engineers, specialists, professors and PhD students trying to emphasize the key achievements which will enable the widespread use of the advanced ceramics products in the High-Tech industry, renewable energy utilization, environmental efficiency, security, space technology, cultural heritage, etc.

Serbian Ceramic Society was initiated in 1995/1996 and fully registered in 1997 as Yugoslav Ceramic Society, being strongly supported by American Ceramic Society. Since 2009, it has continued as the Serbian Ceramic Society in accordance with Serbian law procedure. Serbian Ceramic Society is almost the only one Ceramic Society in South-East Europe, with members from more than 20 Institutes and Universities, active in 9 sessions. Part of our members are also members of the Serbian Chapter of ACerS since 2019. Their activities in the organization of this conference is highly recognized. To them and all of you thanks for being with us here at ACA X.

Dr. Nina Obradović
President of the Serbian Ceramic Society

Dr. Suzana Filipović
President of the General Assembly of the Serbian Ceramic Society

Conference Topics

- Basic Ceramic Science & Sintering
- Nano-, Opto- & Bio-ceramics
- Modeling & Simulation
- Glass and Electro Ceramics
- Electrochemistry & Catalysis
- Refractory, Cements & Clays
- Renewable Energy & Composites
- Amorphous & Magnetic Ceramics
- Heritage, Art & Design

Conference Programme Chairs:

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Dr. Lidija Mančić SRB

Conference Co-chairs:

Prof. Dr. Olivera Milošević SRB
Prof. Dr. Rainer Gadow GER

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Institut za tehnologiju nuklearnih i drugih mineralnih sirovina, Kefo, SCAN

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Ministry of Education, Science and Technological Development RS
Serbian Academy of Sciences and Arts
Institute of Technical Sciences of SASA, Institute of Physics BU
American Ceramics Society – Serbian Chapter
Hotel Palace, Shenemil

Conference Program and Abstracts

Program and Abstract's Contents

The Tenth Serbian Ceramic Conference Advanced Ceramics and Application

Conference Information:

Conference location: Belgrade (Beograd) – the capital of Serbia, Serbian culture, education, science and economy, having about 2.5 million habitants. Belgrade is situated in South-Eastern Europe, on the Balkan Peninsula, at the confluence of the Sava and Danube Rivers in north- central Serbia. The official language is Serbian, while foreigners can use English.
Conference venue: Serbian Academy of Sciences and Arts - SASA, Great Hall (2nd floor) and Halls 2, 3 (1st floor), Knez Mihailova 35, Belgrade, Serbia.
Dress code: Serbian Academy of Science and Arts is a distinguished institution of supreme national importance. We kindly ask you to respect a dress code and not to wear short skirts and pants (above the knee); tank top and sleeveless shirts; flip-flops and open-toed sandals.

Covid-19 outbreak - information for conference participants:
Prevention and general precautions:

- avoid close contact (within 1 m) with people who are ill with fever, cough or respiratory symptoms;
- wear a face covering in enclosed environments;
- wash or sanitize your hands frequently – after coughing, before preparing food or eating, after toilet use, after contact with ill persons, and during exposure to high traffic public areas;
- cover your mouth and nose with a disposable tissue when coughing or sneezing and use the nearest waste receptacle to dispose of it after use. If you do not have a disposable tissue, cough or sneeze in your elbow;
- strictly do not attend the conference if you are unwell. Stay at home or your accommodation if you become unwell, develop a fever or respiratory symptoms;
- if you or other participants in the conference hall are unwell, inform the conference organizers and arrange to get an assessment from a healthcare provider.

Conference fee: Standard fee for foreign participants: 300 EUR; Standard fee for domestic participants: 12000 RSD; **Discounts**: Members of SCS, Invited lecturers and PhD Students: 50%; Plenary lecturers & the last year winners (oral and poster presentations): Free of charge.

Invoice and bank details for Conference fee payment: Banka Intesa ad Beograd, Account No. 160-380150-55, notification: Conference fee – participant name.

Paying of the conference fee and Gala dinner at site will be available only in cash.
Registration:
26. 09.2022 (8.00-9.00A.M.-2nd Floor) & 27.09.2022 (8.00-9.00A.M.–1st Floor)
Posters instalation:
26.09.2022 (16.30-17.00) & 27.09.2022 (8.30-9.00) CLUB SASA
After each session, participants should remove their posters!

Useful telephone numbers:
Police:192
Firemen:193
Ambulance:194

Taxi services: For the taxi services from Belgrade Nikola Tesla Airport to any destination in Belgrade area and further, please contact TAXI INFO desk, located in the baggage area.

Time zone: Belgrade and Serbia are located in the Central European time zone region GMT + 1
Electricity: The electricity voltage in Belgrade is 220V. Electrical outlets are standard EU.
Currency: The official currency in Serbia is dinar, abbreviated RSD. Money may be exchanged in all banks and authorized exchange offices. Exchange rate for 1 EUR is around 118 RSD. Cash may be taken from ATMs 24 hours a day. Credit cards are accepted in shops, hotels and restaurants.
Water: Tap water in Belgrade is safe to drink.

Abstracts and papers publication: The official language of the conference is English. Conference abstracts will be published in the **Book of Abstracts**.
Limited number of papers presented at the conference will be possible to publish in **Science of Sintering.**

Type of presentation: Visuals for oral presentations should be in Microsoft PowerPoint (.ppt or .pptx) or Adobe Acrobat Reader 9 (.pdf). Any animation or video files must be compatible with Windows 7 and Windows Media Player. Bring your presentation to speaking desk at the beginning of the day when your presentation will be. Posters should be prepared in dimension: 70x100 cm. The official language on conference is English.

Additional Conference information president@serbianceramicsociety.rs
http://www.serbianceramicsociety.rs/about.htm

Recommended places near the Conference venue:
Hotel: Hotel Palace, Topličin venac 23; http://www.palacehotel.co.rs/
Exchange office: „Hulk“, Vuka Karadžića 4
Tourist Information Centre: Knez Mihailova 5, http://www.tob.rs/en

Date	Time	Programme		Floor, Room
26th September Monday	**08.00-09.00**	**Registration**		2nd Floor, Hallway
	09.00-09.50	**Opening Ceremony**		2nd Floor, Great Hall
	09.50-10.00	**Short Break & Photo Session**		2nd Floor, Great Hall
	10.00-11.30	**Nano- Opto- & Bio-Ceramic** J. V. Rau B. Marinkovic M. E. Rabanal		2nd Floor, Great Hall
	11.30-12.00	**Coffee Break**		2nd Floor, Hallway
	12.00-14.00	**Nano- Opto- & Bio-Ceramic** V. Rac M. Kuzmanovic Z. Stojanovic M. Vukovic D. Bozanic I. Dinic T. Kovacevic		2nd Floor, Great Hall
	14.00-15.00	**Buffet Lunch**		Club SASA, Mezzanine
	15.00-17.00	**Ceramic & Sintering** R. Gadow W. G. Fahrenholtz M. Omerasevic Lj. Andjelkovic M. Mirkovic		2nd Floor, Great Hall
	17.00-18.30	**Poster Session & Coffee Break**	**Round Table-ACerS**	Club SASA, Mezzanine
	19.30	**Conference dinner**		Palace Hotel
27th September Tuesday	**08.00-09.00**	**Registration & Poster Installation**		1st Floor, Hallway
	09.00-10.00	**Poster Session**		Club SASA, Mezzanine
	10.00-13.05	**Ceramic & Sintering Amorphous & Magnetic Ceramics Hall 2** K. Maca N. Gilli F. Kern V. Marak D. Bucevac F. A. Khan M. Vasic D. Sekulic N. Mitrovic	**Modelling & Simulation Hall 3** M. Huger S. R. Baivier T. Garbowski M. Peric Z. Nikitovic P. Ilias D. Uremovic J. Stojic L. Fiore K. Anrhour	1st Floor
	13.00-14.00	**Buffet Lunch**		Club SASA, Mezzanine
	14.00-16.30	**Electrochemistry & Catalysis Hall 2** Z. Mojovic M. Tisma D. Marinkovic M. Pagnacco M. Rosic M. Miladinovic	**Renewable Energy & Composites Hall 3** S. Blagojevic V. Birdeanu J. Kovac S. Erakovic Pantovic A. Dobrota A. Radulovic	1st Floor
	16.30-17.00	**Coffee Break**		1st Floor
	17.00-19.15	**Cement, Clay & Refractory materials Hall 2** M. Serdar G. Goel E. Nikolic I. Despotovic S. Vucetic J. Bijeljic	**Glass & Electro Ceramics Hall 3** R. Jih Ru Hwu S. Tsai A. Prijic S. Matijasevic V. Paunovic A. Rotaru	1st Floor
	19.15-20.00	**Awards & Closing Ceremony**		1st Floor, Hall 2

Monday, September 26th, 2022.

08.00 – 09.00 **Registration** **Hallway, 2nd Floor**

Great Hall, 2nd Floor

09.00 – 09.50 **Opening Ceremony of the Tenth Serbian Ceramic Society Conference: Advanced Ceramics and Application X**
President of SCS – Dr. Nina Obradović, Short music programme, Prof. Dr. Branislav Ranđelović – about Prof. Dr. Vojislav Mitić, Representative of Serbian Chamber of Commerce, Award ceremony - Dr. Olivera Milošević

09.50 - 10.00 **Short break and Photo Session**

Great Hall, 2nd Floor

10.00 – 11.30 **Nano- Opto- & Bio-Ceramic**
Chairpersons: Lidija Mančić & Smilja Marković

10.00– 10.30 **PL Advanced multifunctional materials for biomedical implants**
Julietta V. Rau[1,2]
[1]Istituto di Struttura della Materia, Consiglio Nazionale delle Ricerche (ISM-CNR), Via del Fosso del Cavaliere, 100 - 00133 Rome, Italy
[2]Sechenov First Moscow State Medical University, Institute of Pharmacy, Department of Analytical, Physical and Colloid Chemistry, Trubetskaya 8, build. 2, Moscow 119991, Russian Federation

10.30 – 11.00 **PL Extrinsic point defects in oxide ceramics: two recent examples of their effects on physical properties**
Bojan A. Marinkovic, Esteban Camilo Moreno Diaz, Jessica Gil Londoño
Department of Chemical and Materials Engineering, Pontifical Catholic University of Rio de Janeiro (PUC-Rio), 22453-900, Rio de Janeiro, RJ, Brazil

11.00 - 11.30 **PL Nanomaterials: size is the key**
A. Ferreiro[1], G. Flores-Carrasco[2], A. Urbieta[3], P. Fernández [3], L. Gomez-Villalba[4], O. Milosevic[5], M. E. Rabanal[1]
[1]Carlos III University and IAAB, High School of Engineering, Avenida de la Universidad s/n, 28911- Leganes, Spain

[2]Tecnológico Nacional de México / ITS de Tepeaca, 75219 Tepeaca, Puebla, México
[3]Complutense University, Facultad Ciencias Físicas, Cuidad Universitaria, Plaza Ciencias 1, 28040-Madrid, Spain
[4]Institute of Geociencias-CSIC-UCM, Calle del Dr.Severo Ochoa 7, 28040-Madrid
[5]Institute of Technical Sciences of Serbian Academy of Sciences and Arts Belgrade, Serbia

11.30 - 12.00 Coffee Break Hallway, 2nd Floor

Great Hall, 2nd Floor

12.00 - 14.00 Nano- Opto- & Bio-Ceramic

Chairpersons: Lidija Mančić & Smilja Marković

12.00 - 12.20 INV Quantifying acidity and basicity of oxides: a calorimetric approach

Vladislav Rac[1], Vesna Rakić[1], Dušan Stošić[2,3], Aline Auroux[4]
[1]University of Belgrade - Faculty of Agriculture, Nemanjina 6, 11000 Zemun-Belgrade, Serbia.
[2]Normandie Univ., ENSICAEN, UNICAEN, CNRS, 14000 Caen, France.
[3]Vinča Institute of Nuclear Sciences, University of Belgrade, P. O. Box 522, 11001 Belgrade, Serbia.
[4]Univ. Lyon, Université Claude Bernard Lyon 1, CNRS, IRCELYON, F-69626 Villeurbanne, France.

12.20 - 12.40 INV Physicochemical and electrochemical characterization of carbon derived from Al- based metal organic framework

Maja Kuzmanović[a], Miloš Milović[a], Milica Vujković[b]
[a]Institute of Technical Sciences of the Serbian Academy of Science and Arts, Knez Mihailova 35/IV, 11000 Belgrade, Serbia
[b]Faculty of Physical Chemistry, University of Belgrade, Studentski trg 12–16, 11158 Belgrade, Serbia

12.40 - 13.00 INV From classical to machine learning aided approach - hydrothermal synthesis planning for metal oxide nanomaterials

Zoran Stojanović, Magdalena Stevanović
Institute of Technical Science of SASA, Knez Mihailova Street 35/IV, Belgrade, Republic of Serbia

13.00 – 13.15 **ORL Hydroxyapatite grafting with alanine amino acid efficiency of different methods**

Marina Vuković[1], Bruna Carolina Dorm[2], Eliane Trovatti[2], Nenad Ignjatović[3], Smilja Marković[3], Srečo Škapin[4], Ivana Dinić[3], Lidija Mančić[3]

[1]Innovative Centre, Faculty of Chemistry, University of Belgrade, Serbia

[2]University of Araraquara - UNIARA, Araraquara, SP, Brazil

[3]Institute of Technical Sciences of SASA, Belgrade, Serbia

[4]Jožef Stefan Institute, Ljubljana, Slovenia

13.15 – 13.30 **ORL Electronic structure of silver-bismuth iodide rudorffite nanomaterials studied by synchrotron radiation soft X-ray photoemission spectroscopy**

D. K. Božanić[1,2], D. Danilović[1,2], A. R. Milosavljević[3], P. Sapkota[4,5], R. Dojčilović[1,2], D. Tošić[1], N. Vukmirović[6], S. Ptasinska[4,5], V. Djoković[1,2]

[1]Department of Radiation Chemistry and Physics, "Vinča" Institute of Nuclear Sciences - National Institute of the Republic of Serbia, University of Belgrade, P.O. Box 522, 11001 Belgrade, Serbia

[2]Center of Excellence for Photoconversion, Vinča" Institute of Nuclear Sciences - National Institute of the Republic of Serbia, University of Belgrade, P.O. Box 522, 11001 Belgrade, Serbia

[3]Synchrotron SOLEIL, l'Orme des Merisiers, St. Aubin, BP48, 91192 Gif sur Yvette Cedex, France

[4]Radiation Laboratory, University of Notre Dame, Notre Dame, IN 46556, USA

[5]Department of Physics, University of Notre Dame, Notre Dame, IN 46556, USA

[6]Institute of Physics Belgrade, University of Belgrade, Pregrevica 118, 11080, Belgrade, Serbia

13.30 – 13.45 **ORL Quantum efficiency of up-converting $SrGd_2O_4$:Yb,Er nanoparticles**

Ivana Dinić[1], Tijana Stamenković[2], Nadežda Radmilović[2], Marina Vuković[3], Mihailo D. Rabasović[4], Vesna Lojpur[2], Lidija Mančić[1]

[1]Institute of Technical Science of SASA, Knez-Mihailova 35/4, Belgrade, Serbia

[2]Department of Atomic Physics, Vinča Institute of Nuclear Sciences, National Institute of the Republic of Serbia, P.O. Box 522, 11001 Belgrade, University of Belgrade, Serbia

[3]Innovative Centre, Faculty of Chemistry, University of Belgrade, Serbia

[4]Photonic Center, Institute of Physics, Belgrade, University of Belgrade, Serbia

13.45 – 14.00 **ORL Thermostable polyurethane composites consisting of bio-based polimer matrix and inorganic mineral reinforcements**

Tihomir Kovačević[1]*, Jelena Gržetić[1], Slavko Mijatov[1], Marica Bogosavljević[1], Saša Brzić[1]
[1]Ministry of Defense, Military Technical Institute, Republic of Serbia

14.00 - 15.00 **Buffet Lunch** **Club SASA**

Great Hall, 2nd Floor

15.00 - 17.00 **Ceramic & Sintering**

Chairpersons: Nebojša Labus & Darko Kosanović

15.00 - 15.30 **PL Process technologies and applications of Basalt fiber reinforced SiOC composites**

Rainer Gadow, Patrick Weichand
Institut für Fertigungstechnologie keramischer Bauteile, Universität Stuttgart, Allmandring 7b, D-70569 Stuttgart, Germany

15.30 - 16.00 **PL Zeta phase tantalum carbide: a high strength, high toughness ceramic**

William G. Fahrenholtz
Missouri University of Science and Technology, Department of Materials Science and Engineering, 222 McNutt Hall; 1400 N. Bishop Avenue, Rolla, MO 65409, United States

16.00 - 16.20 **INV Dense pollucite ceramics obtained by hot-pressing as a potential matrix for the immobilization of cesium ions**

Mia Omerašević
Department of Materials Science, Vinča Institute of Nuclear Sciences - National Institute of the Republic of Serbia, University of Belgrade, 11000, Belgrade, Serbia

16.20 – 16.40 **INV The phase content effect on the functional properties of $BaTiO_3/CoFe_2O_4$ composites prepared by different synthetic methods**

Ljubica Andjelković
University of Belgrade-Institute of Chemistry, Technology and Metallurgy, Department of Chemistry, Njegoševa 12, Belgrade, Serbia

16.40 – 17.00 **INV Synthesis and characterization of high-temperature strontium doped monazite ceramics**

Miljana Mirković
Department Materials, „VINČA" Institute of Nuclear Sciences - National Institute of the Republic of Serbia, University of Belgrade, Belgrade, Serbia

17.00 - 18.30 **Poster Session* (P1-P24) & Round Table ACerS** **Club SASA**

19.30 **Conference Gala dinner** **Hotel Palace**

***16.30 – 17.00** **Poster Installation** **Club SASA**

Tuesday, September 27th, 2022.

Hallway, 1st Floor

08.00 - 09.00 **Registration & Poster Installation**

09.00 - 10.00 **Poster Session (P25-P49)** **Club SASA**

Hall 2, 1st Floor

10.00 - 13.05 **Ceramic & Sintering Amorphous & Magnetic Ceramics**
Chairpersons: Nebojša Labus & Darko Kosanović & Nebojša Mitrović

10.00 - 10.30 **PL Rapid sintering of structural and functional ceramics without application of pressure**

Karel Maca, Vladimír Prajzler, Radek Kalousek, David Salamon
Brno University of Technology, CEITEC, Brno, Czech Republic

10.30 - 10.50 **INV Multi-phase $(Zr,Ti,Me)B_2$ solid solutions: preparation and microstructure evolution**

Laura Silvestroni[1], Nicola Gilli[1], Nina Obradović[2], Suzana Filipović[2], Jeremy Watts[3], William G. Fahrenholtz[3]
[1]CNR-ISTEC, Inst. of Science and Technology for Ceramics, Via Granarolo 64, 48018 Faenza, Italy
[2]Institute of Technical Sciences of SASA, Kneza Mihaila 35/IV, 11000 Belgrade, Serbia
[3]Dep. of Mater. Sci. & Eng, Missouri Univ. of Science and Technology, Rolla, MO, 65409, USA

10.50 - 11.10 **INV Rare earth co-stabilizing of zirconia - an engineering toolbox for creating structural ceramics with tailored mechanical properties**

Frank Kern
Institut für Fertigungstechnologie keramischer Bauteile Universität Stuttgart Allmandring 7B, D-70569 Stuttgart

11.10 - 11.25 **ORL Rapid rate sintering of bulk low-positive thermal expansion material $Al_2W_3O_{12}$ for thermal shock resistance applications**

Vojtech Marak[1], Daniel Drdlik[1, 2], Thais Moreira[3], Bojan A. Marinkovic[3]

[1]CEITEC BUT, Brno University of Technology, Purkynova 123, 612 00 Brno, Czech Republic
[2]Faculty of Mechanical Engineering, Brno University of Technology, Technicka 2, 616 69 Brno, Czech Republic
[3]Department of Chemical and Materials Engineering, Pontifical Catholic University of Rio de Janeiro (PUC-Rio), 22453-900, Rio de Janeiro, RJ, Brazil

11.25 - 11.40 **ORL Al_2O_3-YAG ceramic composite with improved creep resistance**

Dušan Bučevac, Miljana Mirković, Snežana Nenadović, Ljiljana Kljajević, Mia Omerašević
Department of materials science, Vinca Institute of Nuclear Sciences - National Instiute of the Republic of Serbia, University of Belgrade, Belgrade 11000, Serbia

11.40 – 12.10 **PL Structural characteristics, cation distribution, and elastic properties of Cr^{3+} substituted stoichiometric and non-stoichiometric cobalt ferrites**

F. A. Khan[1], M. A. Islam[1], M. A. A. Bally[1], M. Z. Ahsan[2], S. M. Hoque[3]
[1]Department of Physics, Bangladesh University of Engineering and Technology (BUET), Dhaka, Bangladesh
[2]Department of Physics, Military Institute of Science and Technology (MIST), Dhaka, Bangladesh
[3]Materials Science Division, Atomic Energy Center Dhaka (AECD), Dhaka, Bangladesh

12.10 – 12.30 **INV Thermal stability, mechanism and kinetics of thermally induced microstructural transformations of $Fe_{72}Ni_8Si_{10}B_{10}$ amorphous/nanocrystalline composite**

Milica M. Vasić[1], Dragica M. Minić[1]
[1]Faculty of Physical Chemistry, University of Belgrade, Studentski trg 12-16, Belgrade, Serbia

12.30 – 12.50 **INV Memristive properties of amorphous chalcogenides and their application in neuromorphic architectures**

Dalibor L. Sekulić[1], Kristina O. Čajko[2], Svetlana R. Lukić-Petrović[2]
[1]University of Novi Sad, Faculty of Technical Sciences, Novi Sad, Serbia
[2]University of Novi Sad, Faculty of Sciences, Novi Sad, Serbia

12.50 – 13.05 **ORL Structural properties of FeCoV alloys produced by PIM / MIM technology**

Borivoje Nedeljković[1], Vladimir Pavlović[2], Nina Obradović[2], Nebojša Mitrović[1]

[1]Faculty of Technical Sciences, University of Kragujevac, Svetog Save 65, 32 000 Čačak, Serbia
[2]Institute of Technical Sciences of SASA, Knez Mihailova 35, 11000 Belgrade, Serbia

13.00 - 14.00 Buffet lunch Club SASA

Hall 2, 1st Floor

14.00 – 16.30 Electrochemistry & Catalysis
Chairpersons: Maja Pagnacco & Dalibor Marinković

14.00 - 14.30 PL Alumina as electrode material
Zorica Mojović
University of Belgrade, Institute of Chemistry, Technology and Metallurgy, Njegoševa 12, 11000 Belgrade, Serbia

14.30 - 15.00 PL The role of fungi in circular and sustainable bioeconomy
Marina Tišma
Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 18, 31000 Osijek, Croatia

15.00 - 15.20 INV Neat and loaded CaO-based catalysts from natural or waste sources for the triacylglycerols methanolysisis reaction
Dalibor Marinković
University of Belgrade, Institute of Chemistry, Technology and Metallurgy, National Institute of the Republic of Serbia, Negoševa 12, Belgrade, Serbia

15.20 - 15.40 INV The Briggs-Rauscher oscillatory reaction method as a "fingerprint" for bentonite clays
Maja Pagnacco[1], Jelena Maksimović[2], Tihana Mudrinić[1], Marija Ajduković[1], Predrag Banković[1], Aleksandra Milutinović-Nikolić[1]
[1]University of Belgrade, Institute of Chemistry, Technology and Metallurgy, Njegoševa 12, 11000, Belgrade, Serbia
[2]Faculty for Physical Chemistry, University of Belgrade, Studentski trg 12-16, 11000, Belgrade, Serbia

15.40 – 16.00 **INV Examination of the structure and the photocatalyticbehavior of nanostructure $CoMoO_4$**

Milena Rosić[1], Maria Čebela[1], Aleksandra Zarubica[2]
[1]Laboratory for Material Science, Institute of Nuclear Sciences „Vinča“, National Institute of the Republic of Serbia, University of Belgrade, PO Box 522, 11001 Belgrade, Serbia
[2]Department of Chemistry, Faculty of Science and Mathematics, University of Niš, Višegradska 33, 18000 Niš, Serbia

16.00 - 16.20 **INV The ashes obtained from the combustion of agro-industrial waste as catalysts for biodiesel production**

Marija Miladinović
University of Niš, Faculty of Agriculture, Kosančićeva 4, Kruševac, Srbija

16.30 - 17.00 **Coffee Break** **Hallway, 1st Floor**

Hall 2, 1st Floor

17.00 - 19.15 **Cement, Clay & Refractory materials**
Chairpersons: Anja Terzić & Milica V. Vasić

17.00 – 17.30 **PL Diverting local reactive materials from landfill to sustainable construction**

Marijana Serdar
Department of Materials, Faculty of Civil Engineering, University of Zagreb, Croatia

17.30 – 18.00 **PL Valorisation of waste to manufacture eco-bricks: towards circular economy and sustainability**

Gaurav Goel
School of Energy and Environment, Thapar Institute of Engineering Technology, Patiala, 147004, India

18.00 – 18.20 **INV Natural brick of Viminacium**

Emilija Nikolić[1], Ivana Nikolić-Delić[2], Ljiljana Miličić[2], Mladen Jovičić[1]
[1]Institute of Archaeology, Serbia
[2]Institute for Testing of Materials, Serbia

18.20 – 18.40 **INV The application possibilities of waste materials in concrete – the current state in Serbia**

Iva Despotović
Faculty of Mechanical and Civil Engineering in Kraljevo, University of Kragujevac, Serbia

18.40 – 19.00 **INV Red mud utilisation: Hazardous waste or a valuable raw material**

Snežana Vučetić[1], Damir Čjepa[2], Bojan Miljević[1], Jonjaua Ranogajec[1]
[1]University of Novi Sad, Faculty of Technology Novi Sad, Bul. Cara Lazara 1, 21000 Novi Sad, Serbia,
[2]Lafarge BFC doo, member of Lafarge Holcim group, Trg BFC 1, 21300 Beočin, Serbia

19.00 – 19.15 **ORL Possibilities of usage hazardous waste slag in geopolymer mixtures**

Jelena Bijeljić[1], Nenad Ristić[2], Dejan Blagojević[1], Dušan Grdić[2]
[1]Academy of technical and educational vocational Studies Niš, Serbia
[2] Faculty of Civil Engineering and Architecture Niš, Niš, Serbia

19.15 - 20.00 Awards & Closing Ceremony Hall 2, 1st Floor

Hallway, 1st Floor

08.00 - 09.00 **Registration & Poster Installation**

09.00 - 10.00 **Poster Session (P25-P49)** **Club SASA**

Hall 3, 1st Floor

10.00 - 13.05 **Modelling & Simulation**
Chairpersons: Vladimir Buljak & Branislav Ranđelović

10.00 - 10.30 **PL Ability of refractory materials to sustain thermal shocks - how to take advantage of microcracks voluntary introduced within microstructure?**
Marc Huger[1], Damien Andre[1], Nicolas Tessier Doyen[1], Octavian Pop[2], Jean-Christophe Dupre[3], Pascal Doumalin[3]
[1]University of Limoges, CNRS, IRCER, UMR 7315, 12 rue Atlantis, 87000 Limoges, France
[2]University of Limoges, GEMH, EA 3178, F-19300 Egletons, France
[3]University of Poitiers, CNRS, PPRIME, UPR 3346, F-86962 Futuroscope Chasseneuil, France

10.30 - 11.00 **PL Finite element model to better design refractory pieces used in the steel industry**
Séverine Romero-Baivier
R&D Flow Control, Vesuvius, Ghlin, Belgium

11.00 - 11.20 **INV Stochastic calibration methods applied to brittle materials**
Tomasz Garbowski[1]
[1]Poznan University of Life Sciences, Faculty of Environmental and Mechanical Engineering, Wojska Polskiego 28, 60-627 Poznan, Poland

11.20 - 11.40 **INV Theoretical investigation of structural and electronic influences on the magnetic properties**
Marko Perić
Vinča Institute of Nuclear Sciences, University of Belgrade, National Institute of the Republic of Serbia

11.40 - 12.00 **INV Characteristic energy of Ne^+ ions in CF_4 gas**
Željka Nikitović, Zoran Raspopović
Institute of Physics, University of Belgrade, Pregrevica 118, 11080 Belgrade, Serbia

12.00 – 12.15 **ORL Digital image correlation and inverse analysis for characterization of fracture properties**

Ilias Psilakis, Vladimir Buljak
University of Belgrade Mechanical engineering faculty - Strength of materials department, Belgrade, Serbia

12.15 – 12.30 **ORL Algorithm for automatic insertion of cohesive elements for simulation of brittle materials**

Domagoj Uremović, Vladimir Buljak
University of Belgrade Mechanical engineering faculty - Strength of materials department

12.30 – 12.45 **ORL Computational implementation and validation of constitutive models for heat resistant devices**

Jovana Stojić, Dr. Massimo Penasa
CAEmate SRL Innovative Startup, Bolzano, Italy

12.45 – 13.00 **ORL Development of thermoplastic constitutive models for refractory ceramics in wide temperature range**

Lorenzo Fiore[1], Andrea Piccolroaz[2], Severine Romero Baivier[3]
[1,2]Department of Civil, Environmental and Mechanical Engineering University of studies of Trento, Italy
[1,3]Vesuvius Company, Ghlin, Belgium

13.00 – 13.15 **ORL Development of thermal shock protocol of experiment of carbon-based refractory materials**

Kaoutar Anrhour[1,2,*], Séverine Romero Baivier[1], Andrea Piccolraoz[2] , Sébastien Gregoire[3]
[1,3]Vesuvius Group Rue de Douvrain 17, 7011 Ghlin, Belgium
[2]University of Trento Via Mesiano, 77, 38123 Trento TN, Italy

13.15 - 14.00 **Buffet lunch** **Club SASA**

Hall 3, 1st Floor

14.00 – 16.30 **Renewable Energy & Composites**
Chairperson: Milica Marčeta Kaninski

14.00 - 14.30 **PL Surface activity of metal/surfactants interface**

Stevan Blagojević
Institute of general and physical chemistry, Studentski trg 12/V, Belgrade, Serbia

14.30 - 15.00 **PL Surface engineering processes, novel material and their structures for improving corrosion resistance of engineering materials**

Aurel Valentin Bîrdeanu
Infigo Consulting, Romania

15.00 - 15.30 **PL Characterization of surfaces and thin films of advanced ceramics materials by surface sensitive techniques XPS and SIMS**

Janez Kovač
Department of Surface Engineering, Jozef Stefan Institute, SI-1000 Ljubljana, Slovenia

15.30 - 15.50 **INV Improving the electrochemical performance of spray pyrolytic rare-earth cobaltite-based perovskite**

Sanja Eraković Pantović[1], Miroslava Varničić[1], Marija Mihailović[1], Miroslav Pavlović[1], Jasmina Stevanović[1,2], Vladimir Panić[1,2,3]
[1]Institute of Chemistry, Technology and Metallurgy, National Institute of the Republic of Serbia, Department of Electrochemistry, University of Belgrade, Njegoševa 12, 11 000 Belgrade, Serbia
[2]Centre of Excellence in Environmental Chemistry and Engineering - ICTM, University of Belgrade, Njegoševa 12, 11000 Belgrade, Serbia
[3]State University of Novi Pazar, Department of Chemical-Technological Sciences, Novi Pazar, Serbia

15.50 – 16.10 **INV Imperfections in graphene and their role in energy related applications: DFT insights**

Ana S. Dobrota
University of Belgrade – Faculty of Physical Chemistry, Studentski trg 12-16, 11158 Belgrade, Serbia

16.10 - 16.30 **INV Structural characterization and comparative analysis of Ru doped SnO_2 and TiO_2 support materials for Pt-based fuel cells**

Milica P. Marčeta Kaninski, Zoran V. Šaponjić, Mihajlo D. Mudrinić, Dubravka S. Milovanović, Boris M. Rajčić, Aleksandra M. Radulović, Vladimir M. Nikolić
Institute of General and Physical Chemistry, Studenstski trg 12/V, 11000 Belgrade, Republic of Serbia

16.30 - 17.00 **Coffee Break** **Hallway, 1st Floor**

Hall 3, 1st Floor

17.00 - 19.15 **Glass & Electro Ceramics**
Chairpersons: Vesna Paunović & Vera Petrović

17.00 – 17.30 **PL Speech dedicated to the memory of Prof. Dr. Vojislav V. Mitić - Chemical reactivity of buckminsterfullerene C_{60}**

R. Jih Ru Hwu
Department of Chemistry, National Tsing Hua University, Hsinchu 300043, Taiwan

17.30 – 17.50 **INV In memoriam of Professor Dr. Vojislav V. Mitić:The Brownian motion of radicals in DNA cleavage and polyphosphazenes as detoxicants for nerve-agents**

Susan Shwu-Chen Tsay
Department of Chemistry, National Tsing Hua University, Hsinchu 300043, Taiwan

17.50 – 18.10 **INV Consideration of alternative materials for passive heatsinks under a natural cooling conditions**

Aneta Prijić, Miloš Marjanović, Jana Vračar, Aleksandra Stojković, Zoran Prijić
Faculty of Electronic Engineering, University of Niš, Aleksandra Medvedeva 14, 18000 Niš, Serbia

18.10 – 18.30 **INV The analysis of the crystal growth process of the lithium germanium phosphate glass**

Srdjan D. Matijašević[1], Vladimir S. Topalović[1], Veljko V. Savić[1], Nebojša J. Labus[3], Jelena D. Nikolić[1], Snežana N. Zildžović[1], Snežana R. Grujić[2]
[1]Institute for Technology of Nuclear and Other Mineral Raw Materials (ITNMS), 86 Franchet d Esperey St., 11000 Belgrade, Serbia
[2]Faculty of Technology and Metallurgy, University of Belgrade, 4 Karnegijeva St., 11000 Belgrade, Serbia
[3]Institute of Technical Sciences of SASA, Knez-Mihailova 35/IV St., 11000 Belgrade, Serbia

18.30 – 18.50 **INV Electrical characteristics of Sb doped $BaTiO_3$ ceramics**

Vesna Paunović, Aleksandra Stojković, Neda Stanojević, Miloš Marjanović, Zoran Prijić
University of Nis, Faculty of Electronic Engineering, Nis, Serbia

18.50 – 19.10 **INV Society alike porous media**

Andrei Rotaru[1,2], Vlad T. Popa[3]
[1]University of Craiova, Department of Biology and Environmental Engineering, Str. A.I. Cuza, Nr. 13, 200585, Craiova, Romania
[2]Institute of Physical Chemistry "Ilie Murgulescu" of the Romanian Academy, Department of Chemical Thermodynamics, Splaiul Independentei, Nr. 202, 060021, Bucharest, Romania
[3]Institute of Physical Chemistry "Ilie Murgulescu" of the Romanian Academy, Department of Surface Chemistry and Catalysis, Splaiul Independentei, Nr. 202, 060021, Bucharest, Romania

19.15 - 20.00 **Awards & Closing Ceremony** **Hall 2, 1st Floor**

Book of Abstracts

PL1

Advanced multifunctional materials for biomedical implants

Julietta V. Rau[1,2]

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[2]Sechenov First Moscow State Medical University, Institute of Pharmacy, Department of Analytical, Physical and Colloid Chemistry, Trubetskaya 8, build. 2, Moscow 119991, Russian Federation

In the nearest future, a significant increase of biomedical implant demand is expected due to a dominant demographic phenomenon – ageing of population and rising of the life expectancy. Nowadays, the main requests for implants are their good osteointegration and long term stability, possibly accompanied by host bone regeneration process. For these purposes, metallic implants are coated with biomimetic functional ceramic biomaterials substantially improving the properties of metals, creating a proper bone-material interface, and, as a result, leading to a better integration into the surrounding bone tissue. In the present presentation, recent results obtained for biomaterials possessing multiple functional properties designed for coatings on titanium and on novel biodegradable metal alloy implants will be reported. In the case of biodegradable implants, the focus point is the control of their degradation rate and their bioactivity characteristics. The developed coating materials are mainly composed of multi-substituted calcium phosphates and bioactive glass materials of innovative composition, containing trace ions with therapeutic functions, triggering the natural bone tissue response. A crucial aspect of biomedical implant coatings development is their antimicrobial characteristics – a challenging issue for a sustainable medical practice avoiding massive use of antibiotics. In this work, a comprehensive characterization of the developed coatings was carried out, and such properties, as structural, morphological, and mechanical features, wetting contact angle, behaviour in model media, etc. will be reported. *In vitro* cell and microbiology tests data focused on material-cell interactions will be presented.
The results obtained for ion substituted calcium phosphate bioceramics [6] and biomedical cements will be also demonstrated. Such materials possess a broad range of specific functional properties, from antibacterial to magnetic ones. *In vitro* bioactivity and stem cell test results will be reported.
The nanostructured materials developed in this work are promising for new strategies in tissue replacement and regeneration, ensuring required structural, chemical, morphological and mechanical properties, providing a controlled release of active principles and improving long term stability and performances of dental and orthopaedic medical implants.

PL2

Zeta phase tantalum carbide: a high strength, high toughness ceramic

William G. Fahrenholtz

Missouri University of Science and Technology, Department of Materials Science and Engineering, 222 McNutt Hall; 1400 N. Bishop Avenue, Rolla, MO 65409, United States

Zeta-phase carbides have an unusual combination of strengths above 500 MPa and fracture toughness values exceeding 10 MPa•$m^{1/2}$. These ceramics have a narrow range of compositional stability and typically decompose to other carbides when heated above a critical temperature. In the tantalum-carbon system, the zeta phase is stable below ~2400°C with a tantalum to carbon ratio of about 3 to 2. Room temperature strength and fracture toughness values had previously been reported. Recent research in our laboratory utilized reaction-based processing to produce zeta phase tantalum carbide ceramics that were nearly fully dense and contained up to ~96 wt% of the zeta phase. These ceramics exhibited metallic conductivity with electrical resistivity of ~160 ohm•cm at room temperature. The thermal conductivity was about 10 W/m•K, which is about 1/3 of the value of TaC. At elevated temperatures, the strength decreased from about 700 MPa at room temperature to about 180 MPa at 1600°C while the fracture toughness decreased from about 10 MPa•$m^{1/2}$ to 5 MPa•$m^{1/2}$ over the same temperature range. Based on its unusual mechanical behavior, zeta-phase tantalum carbide can be machined using conventional hardened steel tools. The presentation will discuss the mechanisms underlying these interesting properties.

PL3

Alumina as electrode material

Zorica Mojović

University of Belgrade, Institute of Chemistry, Technology and Metallurgy, Njegoševa 12, 11000 Belgrade, Serbia

Alumina (aluminium oxide or Al_2O_3) is one of the well-known ceramic materials. This material is widely used as abrasives, in the production of refractory products and glass, advanced ceramics, medical applications, and military and electronics applications. It is also used as a catalyst and/or catalyst support for various catalytic reactions. Alumina found its various applications in the field of electrochemistry as well: as solid electrolyte, anodic membrane, and corrosion coatings are the most prominent of them.
Most intriguingly, alumina although known as an insulating material, is also used as the electrode material. In recent years it was noticed that the properties of the glassy carbon electrode were enhanced after polishing the electrode with γ-alumina. The morphology and structure of Al_2O_3 particles used for the electrode polishing influenced electrode performances. The investigations were continued with the alumina applied at the surface of the electrode. Strong apparent catalysis of the catechol redox process was noticed in the presence of alumina on the electrode surface leading to the conclusion that the alumina on the electrode surface can act as a catalyst for oxidative process involving a proton-coupled electron-transfer process.

In our approach, three alumina samples with different structure and crystal water content were used as a modifier of the carbon paste electrode. Their electrochemical behavior toward different redox probe was tested. The type of alumina strongly influenced the electrochemical response of electrodes prepared in such a manner. The effect was ascribed to the type and number of surface groups characteristic of the alumina type.

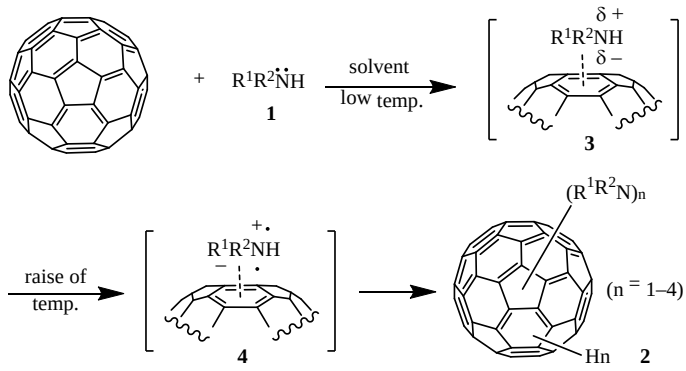
PL4

Speech dedicated to the memory of Prof. Dr. Vojislav V. Mitić
Chemical reactivity of buckminsterfullerene C_{60}

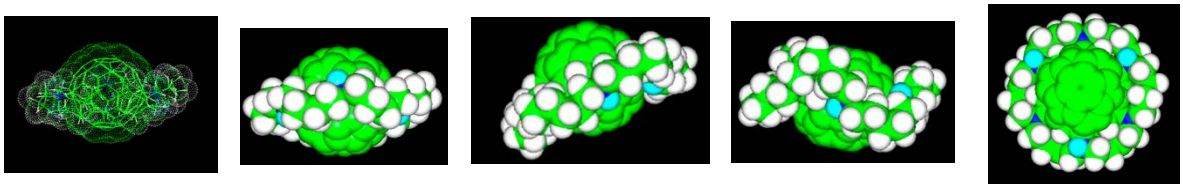
Jih Ru Hwu

Department of Chemistry, National Tsing Hua University, Hsinchu 300043, Taiwan

Unusual properties and reactivity of buckminsterfullerene C_{60} were explored, which reacted more efficiently with amines at low temperatures than at elevated temperatures in organic solvents. The formation of a charge–transfer complex favored to take place at low temperatures. A series of electron spin resonance experiments were performed at various temperatures to detect the formation of $C_{60}^{\bullet -}$. The “low-temperature” acceleration effect on the amination of fullerene C_{60} is discussed in this lecture. The new findings provide an avenue to functionalize buckminsterfullerene C_{60}. These outcomes may offer a chance to enhance its applicability.



"Saturnized fullerene C_{60} molecules" were designed as the cardinal points for cross-linked polymers shown below. Results from the graphic molecular modeling, including the CVFF calculations, indicate that the l,2-adduct $[\text{-N}(CH_2)_6\text{-}]_6 \cdot C_{60}H_6$ with S_6 symmetry is the best target molecule.



PL5

Extrinsic point defects in oxide ceramics: two recent examples of their effects on physical properties

Bojan A. Marinkovic, Esteban Camilo Moreno Diaz, Jessica Gil Londoño

Department of Chemical and Materials Engineering, Pontifical Catholic University of Rio de Janeiro (PUC-Rio), 22453-900, Rio de Janeiro, RJ, Brazil

The role of point defects in oxide ceramics is critical in influencing a vast range of physical properties, such as thermal, optical, electrical, diffusional, density and, in some cases, even mechanical properties. Extrinsic point defects can be formed *via* different mechanisms, such as deliberate aliovalent ion doping, irradiation by high-energy radiation, the presence of inherent chemical impurities, or the surrounding atmosphere during synthesis and/or processing.
As such, reducing or inert atmospheres cause the formation of extrinsic defects, which, when ionized, can inject free electrons and/or electron holes into conduction and valance bands, respectively. These electronic defects, such as free electrons, and holes, could additionally promote intraband energy absorption, through the absorption of energies from the infra-red spectrum, by promoting free carriers to higher energy states, for example, within the conduction band.
The first example examines the hypothesis that the formation of extrinsic oxygen vacancies, accompanied by the reduction of tungsten valency to keep charge neutrality of the crystal phase, provides another mechanism available for tuning of coefficient of thermal expansion in the $A_2M_3O_{12}$ family. $Al_2W_3O_{12}$ has been used as exemplar material for this study.
In the second example, the influence of extrinsic oxygen vacancies on the photocatalytic performance of dark TiO_2-Acetylacetone charge transfer complex for tetracycline and chlorophenol degradation has been studied.

PL6

Valorisation of waste to manufacture eco-bricks: towards circular economy and sustainability

Gaurav Goel

School of Energy and Environment, Thapar Institute of Engineering Technology, Patiala, 147004, India

Current construction practices have caused scarcity of natural resources such as sand and are causing destructive effects on environment. In order to move towards the circular economy as envisaged in European Green Deal, the material from secondary sources should be utilised and construction industry in best suited for utilising these materials. The aim of this study was to explore utilising waste from municipal and industrial origins to be used as substitute for manufacturing fired bricks. This is supposed to serve twin objectives while saving precious natural resources such as soil and utilise the waste material same time. Mineralogical, chemical, and physical characterisation of waste and soil materials was done using

Infrared Spectroscopy, X-ray diffraction (XRD) and scanning electron microscope (SEM) and other analytical methods. Bricks were manufactured by mixing the soil and waste materials in various ratios. After drying these bricks were fired under laboratory environment at firing temperature ranging from 800-900 °C analogous to commercial brick kiln temperature range. Manufactured bricks were characterised by conducting water absorption, apparent porosity, shrinkage, and compressive strength determination. These bricks were found suitable for non load bearing purpose such as making partition wall. The work done enables towards meeting Sustainable Development Goals as Life on land (SDG 15) can only be healthy when waste is properly managed.

Acknowledgements: *This investigation is supported by Seed funding from* Thapar Institute of Engineering Technology *(contract number: TIET/CS/ER/22-23/220014)*

PL7

Nanomaterials: size is the key

A. Ferreiro[1], G. Flores-Carrasco[2], A. Urbieta[3], P. Fernández [3], L. Gomez-Villalba[4], O. Milosevic[5], M. E. Rabanal[1]

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[5]Institute of Technical Sciences of Serbian Academy of Sciences and Arts, Belgrade, Serbia

Nanomaterials deserve special attention since they constitute a kind of material that improves structural and functional properties compared to the bulk material. Nanomaterials have emerged as materials with at least one dimension in the range of 1 to 100 nm. They can be classified into different classes based on their properties, shapes (0D, 1D, 2D, or 3D), or sizes. Nanomaterials possess unique physical and chemical properties due to their high surface area and nanoscale size. They can be produced with outstanding magnetic, electrical, optical, mechanical, and catalytic properties that are substantially different from their bulk counterparts. Their optical properties are reported to depend on the size, which imparts different colors due to absorption in the visible region. Their reactivity, toughness, and other properties are also dependent on their unique size, shape, and structure. In summary, their properties can be tuned by controlling the size, shape, synthesis conditions, and appropriate functionalization.
This talk will review the past, present, and future of nanomaterials. Based on our research developed in recent years in this area, we will review some of the most important milestones we have reached thanks to the collaboration with international research centers. We will mention the semiconductor systems (ZnO, TiO_2,...), nanomaterials with luminescent properties (Gd_2O_3, Eu_2O_3,...), multi/single-wall carbon nanotubes, and many other "exotic" materials due to their small size.

PL8
Characterization of surfaces and thin films of advanced ceramics materials by surface sensitive techniques XPS and SIMS

Janez Kovač

Department of Surface Engineering, Jozef Stefan Institute, SI-1000 Ljubljana, Slovenia

Reactions at surfaces of ceramics materials play an essential role in many ceramics materials applications. There are few analytical methods to reveal surface chemistry at the atomic level. X-ray photoelectron spectroscopy-XPS or ESCA and Secondary ion mass spectrometry - SIMS are two of them and are widely used for the characterization of surfaces, thin films, and nanostructures with very high surface sensitivity (1-5 nm) in the field of catalytic materials microelectronics, perovskite photovoltaic solar cells, fuel cells, ferroelectric thin-film capacitors, implantation materials, sensors, tribology, corrosion, surface engineering…
The XPS method provides data on the quantitative elemental chemical composition, identification of chemical and oxidation state, and bonding of elements at surfaces in thin films and multilayered structures. XPS method is based on the photo effect, i.e., the irradiation of the specimen surface by a monochromatic X-ray beam from an anode or synchrotron light and subsequent analysis of the photoelectrons emitted from the surface in an ultra-high vacuum. Secondary ion mass spectrometry - SIMS is the mass spectrometry of ionized molecules and atoms emitted in a vacuum when a surface is bombarded by focused, energetic primary ions. SIMS technique provides detailed elemental and molecular information with elemental detection limits ranging in the ppm range, sensitivity for hydrogen, and detection of isotopes. It is particularly suitable for the characterization of surfaces of organic materials. A highly focused ion beam allows 2D and 3D chemical and molecular imaging of the surfaces and thin films with submicron resolution.
In the presentation, some recent examples of our XPS and ToF-SIMS surface and thin film analyses, particularly in catalytic materials (TiO_2, TiO_2 + Au + graphene composites Ti-oxynitrides) and perovskite photovoltaic solar cells.

PL9
The role of fungi in circular and sustainable bioeconomy

Marina Tišma

Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 18, 31000 Osijek, Croatia

The European Union's goal of becoming carbon neutral by 2050 represents a special opportunity for industry in general, which, through adaptation and energy independence, can open up many possibilities for the introduction of new environmentally friendly processes and the creation of new (bio)products.
In this work, the main aspects of the circular and sustainable (bio)economy will be presented. Factors that influence the transition from a petroleum-based economy to a circular bioeconomy will be analysed, including key enablers of (bio)economy as well as sustainability indicators.

Fungal biotechnology has the potential to make a significant contribution to support the transition to a circular bioeconomy. The possibility of using fungi for the production of a variety of bio-based products such as food, feed, biochemicals, biofuels, textiles, and biomaterials, including fungal architecture, will be presented.

PL10

Surface engineering processes, novel material and their structures for improving corrosion resistance of engineering materials

Aurel Valentin Bîrdeanu

Infigo Consulting, Romania

During the last decades the surface engineering paradigm was established as a one of the main means to comply with the more stringent and specific requirements of the engineering materials. This concept did lead to the development of a wide variety of processes, materials and simple to very complex structures in response to actual and specific needs related to a wide range of requirements, e.g. tribology, hardness, corrosion resistance, biocompatibility, thermal insulation / conductivity, electrical conductivity, other mechanical properties, etc. and combinations of these properties.
The current speech is presenting some of the work of a group of researchers the speaker is part of, regarding the development of novel inorganic and organic materials (oxides, pseudo-binary oxides and porphyrines), and their combinations in a variety of structures using surface engineering processes (e.g. PLD, drop casting, fast laser texturing, HVOF), in order to improve engineering materials' corrosion resistance. The combination of various surface engineering processes and their processing order in combination with 'classical' and novel materials usage in respect to the improvement of corrosion resistance is tackled also.

PL11

Process technologies and applications of Basalt fiber reinforced SiOC composites

From polymer process technologies to ceramic-like composite performance

Rainer Gadow, Patrick Weichand

Institut für Fertigungstechnologie keramischer Bauteile, Universität Stuttgart, Allmandring 7b, D-70569 Stuttgart, Germany

Polymer Matrix Composites (PMC) are widely used in lightweight engineering applications. The manufacturing technologies are fully developed and raw materials are cheap. Excellent mechanical properties in combination with low density qualify them as an ideal lightweight material. The limiting factors of these reinforced polymers are the useable service temperatures well below 250 °C and poor tribological properties. Promising lightweight composite materials, bridging the gap between PMC and CMC, are manufactured as polymer derived ceramics by the use of polysiloxanes and basalt fibers. Such competitive free formable Hybrid Composites are capable for lightweight applications in a temperature range

between 300 and 850 °C and short time exposure up to over 1000 °C, even in oxidative atmosphere.
In order to qualify the material for series applications, manufacturing technologies like Resin Transfer Moulding (RTM), filament winding, Pultrusion or pressing techniques are employed. Cheap raw materials in combination with performing manufacturing technologies can establish completely new markets for these intermediate temperature composites. The special densification effect in conical extrusion nozzles under simultaneous curing and heating of pulltruded profiles leads to dense composite structures with high fiber volume content and mechanical performance. The pultruded products feature high strength and toughness at high production rates and reasonable cost. Submicron fine filler powders have been introduced to further reduce the shrinkage of the matrix as well as subsequent re-impregnation by low viscosity resins. All these attributes enable the Hybrid Composite as ideal material for fire retardant applications in automotive and public transportation, as well as in fire protection systems in electrical and civil engineering applications.
Beside an increased thermal stability compared to polymeric composites, the Hybrid Composites show excellent tribological properties. An adjustable value of hardness and coefficient of friction open up a wide variety of friction applications from ultra light weight structures for bikes and electrically driven cars to heavy industrial equipment as brake linings for modern skyscraper lift systems. The presentation will comprise a detailed view on the manufacturing processes, a comprehensive (raw-) material characterization and will discuss already proven industrial applications.

PL12

Rapid sintering of structural and functional ceramics without application of pressure

Karel Maca, Vladimír Prajzler, Radek Kalousek, David Salamon

Brno University of Technology, CEITEC, Brno, Czech Republic

The ability to sinter alumina and zirconia ceramics at high heating rates was firstly tested using pressure-less Spark Plasma Sintering which uses pulsed direct current for rapid heating. Extremely rapid densification and grain growth was achieved with heating rates up to 500 °C min^{-1}, so the centimeter-size sample was fully densified without cracks within minutes.
The possibility of fast sintering with conventional resistive heating was then verified in a specially designed furnace at heating rates up to 1500 °C min^{-1}. The mechanisms of heat transfer and the role of surface diffusion during rapid heating were discussed in detail. The origin of the so-called core-shell structure formed during rapid sintering of zirconia ceramics was discovered and possible ways of its elimination were shown. The capability of rapid rate sintering was demonstrated on sintering of lead-free piezoceramic materials, when BCZT powder compacts were for the first time sintered by rapid heating rates within one hour of sintering, while achieving good piezoelectric properties. This finding represents a crucial benefit for the big-scale sintering process in the ceramic industry.

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PL13
Finite element model to better design refractory pieces used in the steel industry

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Refractory pieces used in steel industry, during the continuous casting, are subjected to harsh conditions including chemical, mechanical, and thermal loads. The ability for the refractory to resist to those different attacks determine its performance. Numerical modelling of these phenomena becomes an essential asset provided that the material behavior evolving with temperature is well mastered as well as the boundary conditions.
The paper presents an approach to analyse the performance of refractory piece design in thermomechanical point of view.
The approach features Finite Element modelling accounting for the statistical nature of failure typical for refractories. The models utilise Bigoni-Piccolroaz criterion for multi-axial tensile, shear and compaction failure. The analysis of probability of failure (Fig1.) is based on the ratios between the yield and ultimate function. Necessary material properties, are extracted from laboratory experiments, including Brazilian, and compressive tests with different hydrostatic pressure.

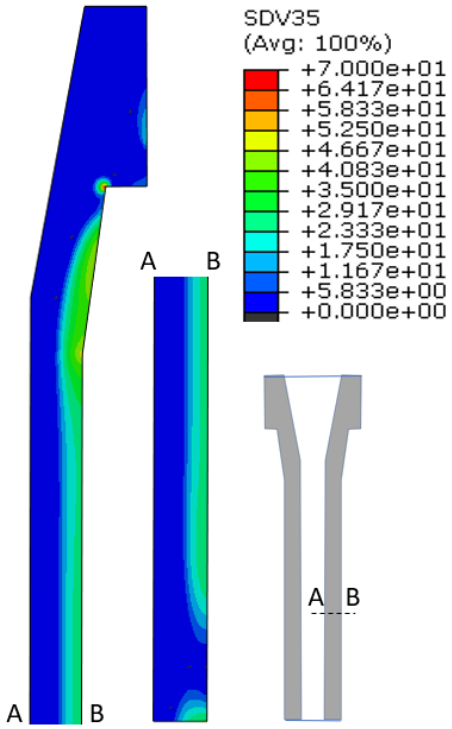

Fig. 1 Probability of failure in LS– condition of the cold start.

PL14
Diverting local reactive materials from landfill to sustainable construction

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In the last decade, due to the increased awareness of climate change and natural resource conservation, the use of blended cements has become the state of the art in current construction practice. Most of the materials on which current blended cements are based are

at high risk of availability and price increases. Both researchers and industry stakeholders agree that there is no one-size-fits-all solution that is optimal for all countries and all climates. However, there is general agreement that for sustainable development in the construction industry, it makes the most sense to use the materials that are found in the region where production and construction are taking place. Therefore, there is a strong need to locate locally available reactive materials which can be diverted from landfill to material supply for the construction industry.
In an effort to provide the regional construction industry with a range of options, a screening of materials available in the region was conducted as part of several projects funded by national and international scientific organisations. Using advanced techniques, the properties of these materials have been analysed to provide information that can be used for application in the construction industry. The most common materials identified were fly ash, slag, and red mud; however, with a limited or unsecure future availability. Since the Southeast European region is rich in clay materials, focus of materials' mapping were clays and limestone. The strategy used was to tailor different materials for different applications, such as low performance/high volume applications and high performance/low volume applications. Some of the specific topics this work will cover are using low kaolin clay and limestone for developing general purpose concrete, using low and high kaolin clay for high-performance concrete and using alkali-activation of regional materials for development of chloride resistant materials.

Acknowledgement: The work of following doctoral students and the projects funding their dedicated work is greatly acknowledged: Matea Flegar and Kiran Ram (Swiss-Croatian research project (grant no. IZHRZO 180590/1), Ivana Vladić Kancir (HRZZ-UIP-05-2017-4767 ABC) and Antonino Runci and Olivera Bukvić (H2020-MSCA-ITN-2018-813596 DuRSAAM).

PL15
Structural characteristics, cation distribution, and elastic properties of Cr^{3+} substituted stoichiometric and non-stoichiometric cobalt ferrites

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Structural, elastic and the cation distribution properties have been investigated on stoichiometric and nonstoichiometric cobalt ferrites for its application as a magneto-caloric material for solid state refrigeration. Crystal structure, formation of spinel type ferrite, chemical bonding, cation distribution, and thermal properties of the two series of Cr^{3+} substituted cobalt ferrites with general formula $Co_{1-x}Cr_xFe_2O_4$, and $Co_{1+x}Cr_xFe_{2x}O_4$ have been studied. The samples are synthesized by the conventional solid-state reaction technique via planetary ball milling. X-ray diffraction (XRD) analysis confirms the formation of single-phase cubic spinel structure with space group Fd3m. Rietveld refinement results show that Cr

occupies both the tetrahedral (A-site) and octahedral (B-site). The experimental lattice parameters show an increasing trend for both the series with the addition of Cr content. The cation–anion vacancies, chemical bonding, and the displacement of oxygen have been evaluated to understand the effect of Cr substitution and how the non-stoichiometry affects the physical and chemical properties of the material. The crystallite size is found to decrease with an increase of Cr concentration for both the series of samples. Specific vibrational modes from the FTIR spectra suggest a gradual change of inversion of the ferrite lattice with the increase of Cr concentration which is also evident from the Rietveld refinement data. The elastic properties analysis reveals that the synthesized samples for both the series are ductile in nature and hence being suitable for machining for device applications. The nonstoichiometric structure with excess Co^{2+} may be promising for lowering of Curie temperature of ferrite which in turn is expected to improve the magnetocaloric properties of the material.

PL16

Ability of refractory materials to sustain thermal shocks - how to take advantage of microcracks voluntary introduced within microstructure?

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This paper is devoted to the study of thermomechanical properties of several industrial and model refractory materials in relation with the evolution of their microstructure during thermal treatments. The aim is, in particular, to highlight the role of thermal expansion mismatches existing between the different phases which can induce damage at local scale. The resulting network of microcracks is well known to improve thermal shock resistance of materials, since it usually involves a significant decrease in elastic properties. Moreover, this network of microcracks can strongly affect the thermal expansion at low temperature and the stress-strain behaviour in tension. Even if these two last tendencies are not very discussed in literature, they constitute for sure key points for the improvement of the thermal shock resistance of refractory materials. Beyond its influence on Young's modulus, this damage also allows to decrease the thermal expansion and to improve the non-linear character of the stress-strain curves determined in tension. Indeed, the occurrence of a large quantity of small precracks during the cooling stage after sintering, which enhances the development of a fracture process zone while loading, allows the decrease of the brittleness of the material which becomes, in this particular case, flexible. The large increase in strain to rupture, which results from this flexibility, is thus of a great interest for the enhancement of thermal shock resistance. A pertinent combination between specific experimental devices for characterization and advance dedicated modelling tools offer new insight for better understanding of these complex aspects closely related to microstructure evolution. Furthermore the intricate behaviour often observed on industrials refractories can be more easily interpreted with the help of parallel studies managed on simplified model materials.

PL17

Surface activity of metal/surfactants interface

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Surface activity of metalic materials surface is of main importance in processes like wetting, cleaning and depositions of thin films.
Determination of contact angle and wetting properties as well as surface tension were done according to standard procedures at 25°C and 45°C. Contact angle was determined by tilting plate method, wetting time (wettability) was determined by immersion method and surface tension of surfactants mixtures was determined by using Traube stalagmometer. The used surfactant was anionic sec-alkan sulphonate (SAS) and nonionic alcohol etoxylate (AEO) and lauraminoxide (AO) in different ratios and total concentration form 0.05 to 0.30%.
The properties of anionic surfactant SAS was improved by adding of AEO and AO. It is clear that addition of nonionic ethoxylated alcohol and lauraminoxide surfactants caused a very pronounced synergism in mixed surfactant formulations. The changes in contact angle and wettability on metalic surface were in the function of surface tension of surfactants mixture. The lower contact angle and the best wettability were obtained with mixture SAS/AEO/AO 9:1:1 and total concentration of 0.20% active surfactants mixture.

INV1
Multi-phase (Zr,Ti,Me)B_2 solid solutions: preparation and microstructure evolution

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ZrB_2 is widely recognized as the most prominent ultra-high temperature ceramic for aero-space applications, in view of its melting point above 3000°C, and despite it exhibits lower oxidation and ablation resistance as compared to HfB_2, it has a much lower density. The addition of TiB_2 further lowers the overall weight, which is a relevant factor for materials intended to flight, but it also worsen the oxidation resistance. In this work, different Me-compounds, where Me = Nb, Hf, Cr, V, are added to the ZrB_2-TiB_2 system to study their effect on the densification, microstructure and thermo-mechanical properties. By adjusting the processing and sintering cycles, fully dense multi-phase ceramics with density in the 5.3-5.7 g/cm^3 range and hardness close to 24 GPa have been obtained. A common feature to all materials, is the formation of solid solutions and microstructural details obtained by x-ray diffraction, scanning and electron microscopy are highlighted. Particularly, we explored the nanotexturing of the shell within micron-sized boride grains of the matrix, which resulted from the preferential precipitation of Me-compounds with poor solubility within ZrB_2 or TiB_2 lattice. Preliminary bending strength and oxidation behavior of these intricate bulk multi-phase ceramics are also provided.

INV2
Rare earth co-stabilizing of zirconia - an engineering toolbox for creating structural ceramics with tailored mechanical properties

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Transformation toughening, a stress induced martensitic phase transformation associated with volume expansion and shear is the main source of toughness and strength in zirconia structural ceramics. The commercially available portfolio of TZP (tetragonal zirconia polycrystal) materials is however very narrow and dominated by yttria and ceria stabilized zirconia materials which either lack toughness and low temperature degradation resistance or strength.
Shifting from co-precipitated starting powders to "stabilizer-coated powders" which are either made by wet chemical methods or by intensive co-milling of monoclinic zirconia and the stabilizer oxides open a new perspective to manufacture TZP materials with very favorable

combinations of strength toughness and low temperature degradation resistance. Stabilizers may either be single rare earth oxides or combinations of oxides with larger and smaller trivalent cations.
By proper selection of starting powders, powder processing and sintering off-equilibrium TZP materials featuring grains with a core-shell structure can be created. The over-stabilized shell ensures good LTD resistance, the under-stabilized core ensures high transformability, transformation efficiency and toughness. Such materials are highly attractive for the biomedical filed but also as a matrix material for e.g. electric discharge machinable composite ceramics with an electrically conductive second phase.

INV3

Quantifying acidity and basicity of oxides: a calorimetric approach

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Given the great many applications of heterogeneous acid-base catalysis, the acidity and basicity of solid oxide catalysts (non-porous, such as ceria, zirconia or titania, or porous, such as zeolites) are considered crucial, among various characteristics which influence their performance. Namely, the concentration of acid/basic sites, their nature and their strengths are the most important parameters. Different methods are routinely being applied in the study of acidity/basicity, most often infrared spectroscopy and temperature programmed desorption. However, in terms of exact quantitative data on acidic/basic site strength distributions, a calorimetric method stands out as exceptional. It is designed to simultaneously record adsorption isotherms of basic (NH_3) or acidic (SO_2) probe molecules and the related thermal effects, via coupling of a calorimeter and a calibrated volumetric line equipped with pressure gauges. Microcalorimetric-volumetric measurements of adsorption yield several sets of results: the total number of sites (μmol/g), the concentration of irreversibly adsorbed probe molecules (number of “strong” sites, μmol/g), integral heats of adsorption (J/g) and differential heats of adsorption (kJ/mol), i.e. the distribution of strengths of the acid/basic sites. Examples of these unique results, which provide a fully quantitative image of acidity/basicity of oxide materials, unparalleled by any other technique, will be presented.

INV4

Synthesis and characterization of high-temperature strontium doped monazite ceramics

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This work aims to obtain a simple pathway for the synthesis of a series of $Ce_{1-x}Sr_xPO_4$ ceramic materials using acetate solutions of Ce and Sr instead of nitrate which were used so far. The preparation method was simple mixing of solutions of $Ce(C_2H_3O_2)_3 \cdot xH_2O$), $Sr(C_2H_3O_2)_2$ and NaH_2PO_4 as precursors at room temperature and the studied compositions were $Ce_{1-x}Sr_xPO_4$ (where x = 0, 0.1, 0.2, 0.3, 0.4, 0.5). Also, the disintegration of Sr in monazite structures in different sintering temperature ranges from 600 °C to 1200 °C was investigated. The evolution of the phase composition with thermal treatment was investigated by X-ray powder diffraction (XRPD). Morphology of sintered ceramics and semi-quantitative chemical analysis were obtained by scanning electron microscopy (SEM/EDS) Rietveld refinement was employed to get the structural information of the synthesized materials. Densification and microstructure evolution was determined using relative geometric density and scanning electron microscopy (SEM). The most favorable conditions for obtaining high-temperature Ce, Sr phosphate-based ceramic material are reported.

INV5

Physicochemical and electrochemical characterization of carbon derived from Al- based metal organic framework

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Carbon materials derived from metal organic frameworks (MOF) have shown promising applications including energy storage and conversion, adsorption, gas storage and separation, catalysis, chemical sensing, and solid phase extraction. Here we present carbon materials derived from Al-based MOFs for use as electrodes in multivalent ion supercapacitors. Al MOFs were synthesized through complexation of fumaric acid with aluminum salts. Carbonization process of Al MOFs was followed by removal of Al_2O_3 via dissolving in NaOH solution. The properties of carbon materials were examined by X-ray diffraction (XRD), Thermogravimetric and Differential thermal analysis (TG/DTA), Fourier Infrared (FTIR) and Raman Spectroscopy, Particle Size Analysis (PSA), Scanning Electron Microscopy (SEM). The charge storage ability of carbon materials were examined in acidic and neutral aqueous solution using Cyclic Voltammetry at scan rates ranging from 5-500 mVs^{-1}.

INV6
Dense pollucite ceramics obtained by hot-pressing as a potential matrix for the immobilization of cesium ions

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A simple one-step method with direct thermal conversion at lower temperatures for removing Cs ions from water and incorporating them into a stable crystal structure that is ready for safe and permanent disposal was described. This stable structure is the one Cs-aluminosilicate phase known as pollucite. Cs-exchanged X zeolite was hot-pressed at temperatures ranging from 800 to 950 ºC to obtain dense pollucite ceramics. It was found that hot pressing decreases the temperature of pollucite synthesis and suppresses the possible volatilization of Cs ions. The influence of sintering temperature on density, phase composition, and mechanical properties was studied. The highest value of density (93 %TD) and compressive strength (79 MPa) was obtained in pollucite hot-pressed at 950 ºC for 3 h. Observation using SEM-BSE shows the heterogeneity of dense ceramics. The pollucite hot-pressed at 950 ºC had a low linear thermal expansion coefficient (4.67×10^{-6} K^{-1}) and showed excellent resistance to Cs leaching. Based on these results one can conclude that hot pressing is the promising method for the permanent disposal of Cs radionuclides.

INV7
Imperfections in graphene and their role in energy related applications: DFT insights

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Ever since its experimental discovery, graphene has been considered a promising material for various applications, and a significant amount of effort has been put into production of high-purity graphene. With the rising need for new, sustainable energy solutions, the energy related applications of graphene have become a focal point of many research group. When it comes to novel electrochemical energy systems, pristine graphene is not the most desirable electrode material, since its reactivity towards species of interest is relatively low (e.g. towards metal ions, for metal-ion battery applications). Introduction of different defects and functional groups into/onto graphene basal plane leads to a change of its geometric and electronic structure, and consequently its reactivity as well. This change is higly dependent on the type and concentration of the introduced defects. Density Functional Theory (DFT) offers theoretical insights into the effects of different dopants on the aforementioned properties of materials. In this talk, an overview of the properties of graphene with various types of defects will be given, including reduced graphene oxide, substitutionally doped graphene and various types of N-containing defects.

INV8

The ashes obtained from the combustion of agro-industrial waste as catalysts for biodiesel production

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The growing trend of biomass utilization for energy production generates a large amount of ash that needs to be managed in a way to reduce its disposal at landfills. Finding a new way of biomass ash utilization in addition to its applications as building materials or fertilizer would be a step forward. The ashes obtained by the combustion of agro-industrial solid waste have stood out as an alternative to conventional catalysts for biodiesel production due to their favorable elemental composition. Replacing the pure chemical compounds used as conventional catalysts with ashes could reduce biodiesel production costs and contribute to sustainability. The studies on several ashes produced by the combustion of walnut and hazelnut shells, and plum and cherry stones aimed to provide information on their characteristics and catalytic properties. The results revealed the similarity and difference in the elemental and phase composition, morphology, and textural parameters. The dominant elements such as potassium and calcium had a significant effect on the catalytic performance of ashes. Considering that ash-based catalysts can be recovered and reused, there is great potential for their application in the catalytic process of biodiesel production.

INV9

Characteristic energy of Ne^+ ions in CF_4 gas

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Charge transfer reactions of ions with molecules are unavoidable elementary processes in modeling kinetics in terrestrial, industrial and astrophysical plasmas in dark matter detection. Motivational factors for this study are identified and this paper reports on a topic important both for fundamental studies and for applications. A cross section set for scattering Ne^+ ions in CF_4 gas is assessed by using available experimental data for charge transfer cross sections. The Monte Carlo technique was applied to perform calculations of transport parameters. Calculated cross sections can be used to obtain transport coefficients, specially characteristic energy and rate coefficients for low and moderate reduced electric fields *E/N* (E-electric field strength; N-gas density) and accounting for the non-conservative collisions.

INV10

The analysis of the crystal growth process of the lithium germanium phosphate glass

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The crystal growth rate of lithium germanium-phosphate glass was studied. The glasses have been homogenized using the previously established temperature-time conditions, which make it possible to remove a volatile substances from the glass melt. The AAS was used to determine the chemical content of obtained glass, the differential thermal analysis (DTA), and scanning electron microscope (SEM) were used to reveal the isothermal process of crystal growth, respectively. It has been found that the experimental determined crystal growth rate has a tendency toward of exponentially increase with an increase the temperature.

INV11

Electrical characteristics of Sb doped $BaTiO_3$ ceramics

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In this paper, the microstructural and dielectric characteristics of Sb doped $BaTiO_3$ ceramics were investigated. The concentrations of Sb ranged from 0.1 to 5.0 at%. The conventional solid-state sintering method at temperatures of 1290 °C - 1350 °C was used to obtain samples. SEM analysis of ceramics doped with a lower concentration of additives (0.1 and 0.5 at%) showed fine-grained and uniform microstructure with grain size from 0.5 μm to 3.0 μm. In samples doped with a higher concentration of additives (1.0 and 5.0 at%), the characteristic grain size ranged from 2.0 μm to 5.0 μm.
Measurement of electrical characteristics was performed at room temperature in the frequency range from 100 Hz to 1 MHz. In the sample doped with 0.1 at% Sb and sintered at 1290 °C, the value of the dielectric constant is ε_r=2800. Whit increase of dopant concentrations the dielectric constant value decreases. The sample doped with the same concentration (0.1 at% Sb), but sintered at a temperature of 1350°C, has a higher value of the dielectric constant of ε_r=8010.
The changes in electrical resistivity with frequency are also analyzed in this paper. Samples sintered at the highest temperature have the lowest value of electrical resistivity, and with increasing frequency, it decreases. At the same sintering temperature, and with increasing impurity concentration, the resistance increases.

INV12
Consideration of alternative materials for passive heatsinks under a natural cooling conditions

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Passive aluminum heatsinks with pin or plate fin geometry are commonly employed in various systems for heat exchange with the environment. An increase in the heat dissipation within the limited space and under natural cooling conditions imposes the utilization of other heatsink materials and geometries. Alternative materials could also provide insulating electrical properties, electromagnetic compatibility, no antenna effect, high dielectric strength, a small overall volume, and lightweight. Among used heatsink materials are alumina, different microporous ceramics, and microporous metal foam, while geometries include low-profile ribbed or flat designs. This paper presents a performance comparison of four non-standard heatsinks (made of solid alumina - $Al2O_3$, microporous alumina, and microporous Cu foam) with one aluminum heatsink of similar dimensions under natural cooling conditions. The considered heatsinks were employed as heat dissipation elements from the cold side of the selected standard thermoelectric generator (TEG - MCPF-031-10-25). The preset temperature difference between TEG hot side and the ambient was suddenly imposed, and the assembly TEG-heatsink thermal and electrical responses were monitored. The heatsink effectiveness estimation is based on the values of the voltage transferred to the load by the TEG for the different temperature gradients. The experimental setup was accompanied by appropriate numerical simulations to validate the models of alternative materials' thermal parameters. The obtained results indicate that heatsinks made of alumina and microporous materials having similar external dimensions perform the same in the considered temperature range. They have about 15% lower efficiency than the aluminum heatsinks but simpler geometry and applicable electrical insulating properties. The presented results are significant in designing the systems operating under natural cooling conditions or within the limited space, like thermal harvesting wireless sensor network nodes, LED lighting housing, and PC case.

INV13
The phase content effect on the functional properties of $BaTiO_3/CoFe_2O_4$ composites prepared by different synthetic methods

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The $CoFe_2O_4$ nanoparticles were *in situ* synthesized on commercial $BaTiO_3$ by thermal decomposition, coprecipitation, and microemulsion method. After initial preparation procedures, the obtained powders were sintered at 1150 °C and 1300 °C in a pellet form. The

bare powders, as well as sintered pellets, were thoroughly characterized by X-ray powder diffraction and scanning electron microscopy coupled with electron dispersive spectroscopy. The impedance spectroscopy, dielectric, and ferroelectric measurements were used to get deeper insight into electrical properties of prepared materials. Better dielectric properties were achieved for samples sintered at 1300 °C, irrespective of chosen synthetic route. The different phase content obtained by three chosen synthetic procedures influenced different electrical properties of the investigated samples. The sample prepared in a microemulsion manner and sintered at 1300 °C showed the best dielectric performances which can be explained by the highest amount of barioferrite-like phase and the lowest amount of undesired centrosymmetric P4/mmm $BaTiO_3$ phase. Although well-defined electric hysteresis loops were not achieved, the sample synthesized by thermal decomposition showed electrical hysteresis most similar to conventional hysteresis loop of ferroelectric materials owing to highest amount of $BaTiO_3$ phase.

INV14

Thermal stability, mechanism and kinetics of thermally induced microstructural transformations of $Fe_{72}Ni_8Si_{10}B_{10}$ amorphous/nanocrystalline composite

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Amorphous and nanocrystalline iron based alloys have been attracting great scientific attention due to their applicability in various field of modern industry, resulting from their favorable magnetic, electrical, mechanical and chemical properties. Thermodynamic and kinetic metastability of these materials make them prone to structural transformations, which can deteriorate or improve their functional properties. Thermal stability, mechanism and kinetics of thermally induced microstructural transformations of soft magnetic $Fe_{72}Ni_8Si_{10}B_{10}$ alloy with composite amorphous/nanocrystalline structure were studied. Multistep microstructural transformations starting at around 500 ºC were observed. Influence of chemical composition and microstructure of the alloy sample on its thermal stability and corrosion resistance in various environments was analyzed using structural and electrochemical techniques. Examination of corrosion characteristics of individual sides of the alloy ribbon contributed to a deeper understanding of the corrosion performance of the studied alloy. In spite of the fact that such alloys exhibit optimal soft magnetic properties in partially crystalline form, composed of large fraction of very small crystals, the alloy with such structure was shown to be most susceptible to corrosion, which should be taken into account when choosing an alloy microstructure for specific application.

INV15

Examination of the structure and the photocatalytic behavior of nanostructure $CoMoO_4$

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Materials processing techniques, such as the combustion process, seem to hold much promise for the preparation of technologically important $CoMoO_4$, owing to the control over stoichiometry, homogeneity and purity. Concerning the photocatalytic outness and powder characteristics, a glycine nitrate procedure (GNP) of $CoMoO_4$ nanopowders by a glycine as a fuel and as a complexant was inspected. The synthesized samples were investigated by differential thermal analysis (DTA), Fourier transform infrared spectroscopy (FTIR), X-ray diffraction (XRD), Field emission scanning electron microscopy (FESEM), Ultraviolet-Visible (UV/Vis) spectroscopy and nitrogen adsorption method. The glycine nitrate procedure (GNP) is simple, effective and suitable method for controlling the composition and morphology of $CoMoO_4$. A single-phase α and β crystalline form of $CoMoO_4$ compound was confirmed by DTA and X-ray diffraction (XRD). The obtained $CoMoO_4$ nanopowder showed tendency of agglomeration, inhomogeneous microstructure and plate-like crystals. The photocatalytic activity of $CoMoO_4$ nanopowders was assessment by the photocatalytic degradation of crystal violet in aqueous solution. In addition, the obtained specific $CoMoO_4$ nanopowder demonstrated acceptable specific surface area, which can be of particular importance for the photocatalytic processes. The photocatalytic testing of $CoMoO_4$ nanopowders showed that these nanostructured materials can be promising solutions in photocatalytic processes toward green chemistry and sustainable development.
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INV16

Structural characterization and comparative analysis of Ru doped SnO_2 and TiO_2 support materials for Pt-based fuel cells

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Here we report the preliminary results of ongoing comparative study of the transition-metals oxide based nanocrystalline support materials for direct ethanol fuel cells. The interactive Ru-

doped SnO_2 and TiO_2 nanocrystaline support materials were synthesized in ratio Ru/(Ru+M) = 1, (M = Sn, Ti). The nanostructured Pt catalyst was deposited subsequently on the surface of metal oxide support materials applying ethanol reduction reaction. The electron-microscopy imaging revealed uniform size distribution of the agglomerated support nanoparticles. X-ray powder diffraction analysis of both support materials revealed significant diffraction peaks broadening suggesting nanocrystalline nature of support materials. All diffraction peaks in XRD pattern of Ru-doped SnO_2 are indexed as cassiterite suggesting no secondary phases present in synthesized material. Ru-doped TiO_2 support synthesized using titanate nanotubes as precursor, was indexed as anatase phase with two low-intensity additional peaks corresponding to minor amount of un-reacted RuO_2 phase. The shift of diffraction peaks in XRD patterns of both Ru-doped SnO_2 and TiO_2 support materials indicates unit cell volume changes which are consistent with the incorporation of the Ru ion into SnO_2 and TiO_2 crystal lattices. The preliminary results of examination of the electrocatalytic activity toward ethanol oxidation under acidic conditions, showed better performance for Ru-doped TiO_2 support compared to Ru-doped SnO_2.

INV17

The Briggs-Rauscher oscillatory reaction method as a “fingerprint” for bentonite clays

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The oscillatory Briggs-Rauscher (BR) reaction was applied on solid insoluble materials - bentonite clays from different deposits: Wyoming (Swy-2), Texas (STx-1b), Idaho (SbId-1), Arizona (SAz-2), Bogovina and Mečji Do, last two from Serbia. Under the same BR experimental conditions, the addition of identical masses (0.25 g) of particular clay resulted in different effects on oscillatory dynamics. There is a prolongation, quenching, or no influence on oscillatory dynamics. Additionally, in the case of different masses of clay added, the response of the BR oscillating system resulted in a complex behavior pattern (oscillatory period vs. bentonite mass). This complex behavior pattern (firstly obtained by using clays in BR), could be applied as a fingerprint for bentonite identification. It is supported by facts that montmorillonite/beidellite ratio, cation exchange capacity, principal exchange cation, the extent of iron leaching in the acidic environment of BR reaction, and specific surface area of each used clays were *not* exclusively responsible for observed behavior in oscillatory reaction. This means that all bentonite’s properties combined are probably responsible for behavior obtained in oscillatory reaction, making BR reaction as an easily available and economical method for the identification of bentonite clay origin.

INV18

In memoriam of Professor Dr. Vojislav V. Mitić: The Brownian motion of radicals in DNA cleavage and polyphosphazenes as detoxicants for nerve-agents

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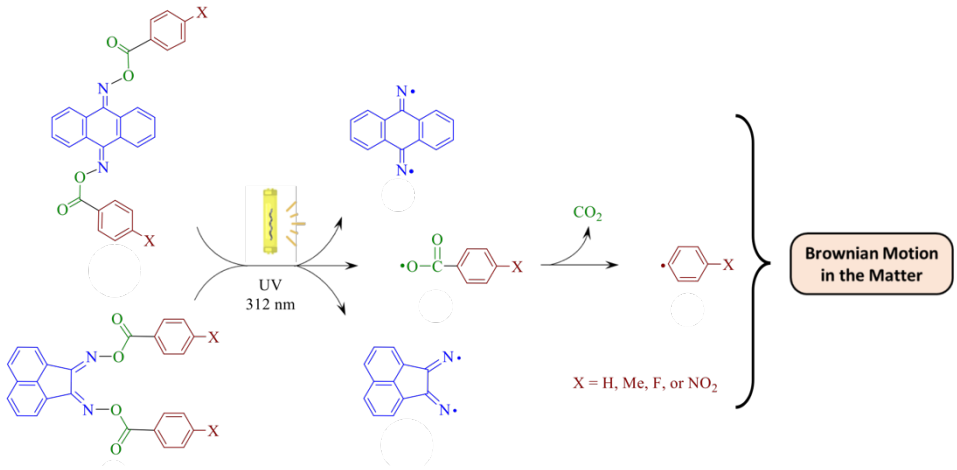
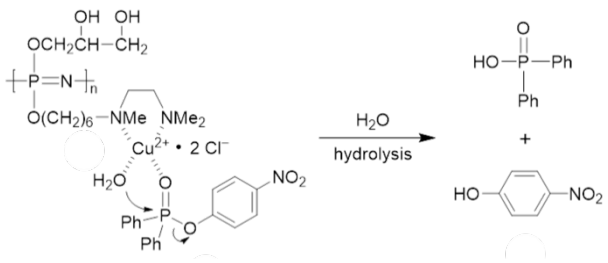
It has been experimentally determined that certain organic radicals participate in DNA cleavage.[1,2] Such compounds are of great value in photodynamic therapy and gene therapy. Series of oxime ester conjugates equipped with intercalating moieties were designed and synthesized. These conjugates were found to cleave DNA upon UV irradiation at room temperature. The idea to establish an ordering of radicals is related to their capacity in DNA cleavage. Hence the stochastic movement of each radical may have certain specificity or regularity, which is associated with fractional Brownian motion.



Novel copper (II)-containing random copolyphosphazenes were developed for the hydrolysis of chemical warfare agents for nerve, such as sarin.[3] These polyphosphazenes containing glycerol, *N*,*N*,*N*′-trimethyl-*N*′-(6-hydroxyhexyl)ethylenediamine and Cu(II) were synthesized in seven steps. These copolymers possess bifuntional characteristics: the glyceryl units therein increase water solubility and copper(II)-coordinated diamino groups can hydrolyze a phosphate agent. Their skeleton underwent hydrolysis to yield glycerol, diamine, phosphoric acid and ammonia. The self-degradability characteristic of the new copolymers is desirable in view of environmental protection.



INV19

Theoretical investigation of structural and electronic influences on the magnetic properties

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The understanding of magnetic properties of metal complexes allow us to predict and design molecules and materials with required characteristics, which can be used to store the informations on quantum level. Molecular magnets, i.e. mononuclear systems with large magnetic anisotropy value are in the focus of interest due to their potential applications in quantum computing. Through the analysis of the factors that determine the magnetic properties of mononuclear complexes, it has been shown that $[NiCl_3(Hdabco)_2]^+$ (dabco=1,4-diazabicyclo[2.2.2]- octane) exhibit very high values of axial splitting parameter, D. The main cause for such a large value lies in interactions between d_{x2-y2} and d_{xy} metal orbitals. The effects of Jahn-Teller distortion, which act opposed to spin-orbit coupling, are suppressed by the presence of voluminous dabco ligands, which are placed in axial position. Due to the steric hindrance of axial ligands, the chlorine atoms in equatorial plane can not move easily. Magnetic couplings between paramagnetic centers in binuclear complexes can be successfully analyzed using Broken Symmetry (BS) DFT method. The strength of magnetic interactions depends upon the electronic structure and the structure of bridging ligands. The distortions in the bridge region lead to a significant weakening of antiferromagnetic interactions. Detailed examinations have shown that highest values of coupling constants can be observed for complexes of nickel (II) and copper (II) due to the σ interactions between d metal orbitals and p bridging ligand orbitals. Furthermore, the rising number of unpaired electrons per metal center leads to the increase of antiferomagnetic and feromagnetic interactions at the same time. The antagonistic effects cancel each other, causing very small values of coupling constants. Magnetic interactions that are transmitted through the hydrogen bonds strongly depends on the orientation and arrangement of hydrogen bridges. In most examined cases Jahn-Teller distortion is the main cause of the absence of coupling.

INV20

Improving the electrochemical performance of spray pyrolytic rare-earth cobaltite-based perovskite

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Recently there is an effort to reach highly reversible and stable materials for energy storage processes. Novel materials used in electrochemistry-based energy storage as a suitable supports for noble ones, has been predominant in the past few years. Supercapacitors, as a bridge between batteries and traditional capacitors, have attracted significant attention as new promising energy storage devices. Hybrid nanomaterials based on manganese, cobalt, and lanthanum oxides of different morphology and phase compositions were prepared using a facile single-step ultrasonic spray pyrolysis (USP) process. Transition metal oxides are considered as an ideal electrode materials for electrochemical redox transitions-based pseudocapacitors, because they can provide a variety of oxidation states for rather fast and efficient redox transitions. Strontium-doped lanthanum cobaltites ($La_{1-x}Sr_xCoO_{3-\delta}$, LSCO) have shown promising catalytic performance for ORR in alkaline media. The aim of this investigation was to bring detailed insights of supercapacitive potentials of pure LSCO and LSCO hydrothermally doped by RuO_2. Also, to separate influences of constituting oxides to this issue, in order to reveal the redox electrochemistry behind perovskite structures as supports for supercapacitive applications. As well as to synthesize and investigate hybrid nanomaterials based on the Mn/Co/La oxides of ordered structure generated by USP as electrocatalyst for ORR.

INV21

Stochastic calibration methods applied to brittle materials

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Stochastic methods based on Gaussian processes allow to build not only a surrogate model but also to build an approximation accuracy map. This is particularly important when the goal is to calibrate a model that has multiple parameters, for example due to otrotropy in elasticity or a complicated description of plasticity and / or failure. In such a case, each point in the multidimensional parameter space should be chosen very carefully so as not to unnecessarily generate iterations with time-consuming calculations, and at the same time systematically

minimize the function, which often has many local minima. Undoubtedly, the identification of constitutive parameters in brittle materials belongs to this group of issues. The article presents a method of calibrating the problems of non-convex functions of many variables. The method is based on an iterative refinement of the representation of the objective function composed of its expected value and corresponding uncertainty. The new points used to update the approximation are selected so as to explore the parameter space in search of the global minimum and at the same time reduce the standard deviation of the estimation where the greatest mapping inaccuracies occur. The presented algorithm is characterized by high efficiency and speed of calibration of even very complex models.

INV22

Natural brick of Viminacium

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Building activity in Viminacium, an important Roman legionary fortress and a city on the Danube in today's Serbia, was influenced by its natural surroundings. They influenced the position and orientation of the first fortification, built in the 1st century AD, as well as the range of raw materials for the construction of buildings in all of Viminacium's life phases. The first building material along with wood that Romans encountered after coming to the northern edge of the Stig Plain must have been red burnt soil created by coal combustion, whose source is only a few kilometres from the fortress. The first ramparts were constructed using blocks made of this material, called "crvenka" by the local people, which was used for building purposes in the wider area until relatively recently. It is very well known that man-made brick was used as an artificial material with pozzolanic features added to Roman lime mortars. Viminacium was a provincial centre of brick production, using local soil as a raw material. Since crvenka can be recognised as a kind of "natural brick" made of local sediments, an assumption was made that it could also have been used in Viminacium lime mortars as a natural pozzolanic addition. After laboratory research of its mineralogical, mechanical, physical, and chemical characteristics, crushed and ground crvenka was mixed with lime. Mortars with excellent mechanical properties were created, offering us one of the indicators of their possible hydraulicity. With the knowledge of the firing temperatures that could have been developed in Roman brick kilns, this research will be continued. An attempt to determine the temperature that red ceramic fragments, visible in the composition of Viminacium mortars, were fired at, will be made, leading us further towards their possible characterisation as artificial or "natural" brick.

Acknowledgments
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INV23

From classical to machine learning aided approach - hydrothermal synthesis planning for metal oxide nanomaterials

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In the past decade, scientists have made an outstanding progress in machine learning techniques, based on natural language processing, that takes advantage of vast number of material science documents to gain novel aspects on materials synthesis. Herein, we are comparing hydrothermal synthesis recipes for obtaining metal oxide nanomaterials carried out in our laboratory with learned synthesis recipes in terms of precursors, processing parameters, steps and product characteristics. As a starting point, open source tools and pre-trained models are used to get optimal hydrothermal synthesis recepies for desired material. This new approach is showing a great potential to become a standard method in planning viable synthesis routes for new materials.

INV24

Memristive properties of amorphous chalcogenides and their application in neuromorphic architectures

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Neurons and synapses, the basic building blocks of the neural systems, operate on a fundamentally different processing paradigm and have a much better performance in comparison to conventional computing systems based on the von Neumann architecture. The key distinction between neuromorphic and traditional logic-gate based computing is the use of neuromorphic devices which are designed behave similar to neurons in the brain. The memristors have recently been used as building blocks of artificial neural processing since they possess basic forms of neuroplasticity that are able to emulate brain-like functionality. Namely, these two-terminal electrical components can change their resistive state in response to external stimuli, similar to the plasticity mechanism found in biological neurons This study reports the memristive properties of the metal/amorphous chalcogenide/metal structures based on Ag-doped As–S–Se chalcogenide glasses. The bipolar resistive switching characteristic was observed in all samples, which possess good ratio between the resistances of high- and low-resistance states at low current values. A transition between the opposite hysteresis loops is possible by voltage control, and the presence of Ag in chalcogenides is critical to achieving reversible resistive switching by formation and rupture of the conductive silver filament across the switching layer. In addition, preliminary numerical simulations based on experimental characterization results have shown that the studied memristive structures can be applied in the realization of an artificial neuron using leaky integrate-and-fire neuron model.

INV25

The application possibilities of waste materials in concrete – the current state in Serbia

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The construction industry uses vast amounts of natural resources, simultaneously producing significant amounts of debris, which has a large impact on the environment. Annual production of concrete in the world has reached 14 billion m^3 which classifying it as the most widely used construction material. Regards to the fact that about 70% of concrete is actually an aggregate, it is clear how much of the quantities of natural and crushed aggregates is required. The uncontrolled exploitation of aggregates from rivers seriously disrupts aquatic ecosystems and habitats, while production of crushed natural aggregates increases emission of harmful gases, primarily CO_2, responsible for the greenhouse effect. These gases are produced during rock mining and also transportation of aggregates to the usually distant urban areas. Also, cement factories produce about 7% of global CO_2. On the other hand, the amount of construction waste generated during construction and demolition process, as well as the amount of industrial waste, are growing rapidly. The problem of waste disposal is usually resolved by established (which are occupying large areas and waste disposal is expensive) or "wild" - illegal dumps. If we used any of the industrial by – products, such as fly ash, silica fume, biomass, or try to reuse glass from e-waste and old concrete - we would solve the problem of depositing these materials, and thus made concrete ecological material. This paper presents the current state in this field in Serbia.

INV26

Society alike porous media

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Recently, the entire world has experienced a feverish condition induced by the accelerated spread of what is generically known as Covid-19, while major hidden problems of society were suddenly revealed. Here we show that a novel concept for society perceived as a porous medium as we know them in many ceramic materials is effective for substantiating its true nature and twigging its evolution; relations among its constituents are defined and explained in an extensive manner, while the functional mechanisms were rigorously established. This physical model with a fractal-like structure crystallizes social hierarchies into an assembly of similar patterns, forming a unique and solid structure that accurately describes the essence of

society. It enables a shift of paradigms within a diverse spectrum of sciences (social, political, medical, etc.), hence wielding significant matters. We found that specific terms like porosity (θ) and tortuosity (τ) characterize the activity of individuals inside social systems, and respectively stand for the difficulties these encounter. Our results demonstrate that a package of measures consisting of the pair $\{\theta; \tau\}$ belongs actually to a certain frame of political ideology; it equates the permissibility of the system, which is actually a direct measure for the impact created by a highly-important issue (*e.g.* medical: a respiratory virus outbreak). We forestall that this breakthrough will provide precise means for better understanding and efficient management of the current SARS-CoV-2 pandemic. For such situations, positive outcomes have been achieved in practice exclusively via a proficient oligarchic form of leadership.

INV27

Red mud utilisation: Hazardous waste or a valuable raw material

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Currently there is a high research interest for effective use of red mud, the main waste product from the Bayer's process. Various applications of red mud have been explored (adsorbents for heavy metals, recovery of iron, etc.), with additional promising approaches: production of cement, and ceramic tiles and bricks. These proposed uses, which are in line with the principles of circular economy, could reduce the cost of raw materials and the environmental footprint. However, high alkalinity of this material is still a limiting factor for wider application in construction materials industry.
The aim of our research was the valorisation of red mud from regional Alumina plants in Montenegro and Bosnia&Herzegovina for production of ceramic materials and cements. Thermal, chemical, mineralogical, and morphological characteristics, particle size distribution, and effects on health and environment were studied. Based on the obtained results, ceramic materials and cements were produced and characterised considering microstructural, textural, and mechanical properties. The effects of raw mixes' composition, firing temperature, and time on phase formation were also investigated. The obtained results showed it is possible to produce ceramic materials and cements with good characteristics by using red mud (up to 80 mass%) and up to 50 mass% in cements.
Acknowledgements The authors would like to acknowledge the support from Ministry of Education, Science and Technological Development (Serbia), project No.: 451-03-9/2022-14/200134 and project RIS-RESTORE – Evaluation of Red Mud Tailings in the ESEE region, EIT RawMaterials, Horizon, 2020.

INV28

Neat and loaded CaO-based catalysts from natural or waste sources for the triacylglycerols methanolysisis reaction

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In recent decades, especially in recent years, more and more attention is focused on energy consumption, energy efficiency, fossil fuels emission and depletion, and alternative energy sources and uses. Biofuels, such as biodiesel, are significant competitors to fossil diesel fuel, in particular when a modern approach to biodiesel production is involved. Waste or non-edible feedstock, waste-based catalysts and reactor intensification are the key for this innovative strategy. CaO as a cheap, easily available from waste and natural sources, possess good catalytic activity, so is imposed as a desirable catalyst in the transesterification reaction.
This work systematically presents methods for the CaO-based catalysts synthesis, their activity in the methanolysis reaction, their stability during manipulation, as well as the reason for their deactivation. Neat catalysts obtained from waste egg shell and catalysts where CaO was loaded on gamma-alumina and zeolitic carrier (obtained from waste fly ash formed by burning coal in a thermal power plants) were compared. Also, several different types of reactors were used, batch stirred, packed bed tubular reactor and microreactor. Catalysts performance in reaction with edible sunflower and waste cooking oil was considered.

ORL1

Computational implementation and validation of constitutive models for heat resistant devices

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In the past century, we have witnessed the increasing demand for the steel in various spheres of population's everyday activities. Although the use of this metal became an absolute necessity, remarks have to be made on its significant impact on the environment, including air emissions (CO, SOx, NOx), wastewater contaminants, hazardous and solid wastes. Because of their high performance in extreme conditions, ceramic materials are essential in the steel manufacturing. This is the reason why the reduction of their ecological footprint is growing into one of the most burning topics. In order to understand better the behavior of these materials, it is important to rely on the trustworthy models, which can simulate the material's peculiarities. By simulating and comparing the results obtained from different modeling approaches (including damage, thermoplasticity, viscosity), it will be possible to establish, for the first time, the in-silico reproduction of refractures' nature over the whole working temperature range. Identification of material constitutive parameters and their optimization are performed with the help of a combination of experimental tests and multi-objective optimization. The constitutive models for the mechanical description are implemented into a numerical code, calibrated based on the experimental data and validated. The final goal of the present research is developing a novel material model accounting for viscosity, damage, aging and thermoplastic effects. This highly-flexible material model will be adapted for different ceramic mixes deployed in the industry and engaged in finite element simulations of the industrial processes in various finite element codes. The present research is supported by the EU within the H2020-ITN-REFRACTURE2 research project.

ORL2

Digital image correlation and inverse analysis for characterization of fracture properties

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Quantifying displacement field over the specimen by exploiting photos taken during the experiment through diverse digital image correlation algorithms becomes more popular alternative to traditional strain gauges. While the latter can provide only a local deformation in the zone where the gauge is applied, the former can give a full field displacement over the wider range of tested specimen. Based on collected data, kinematic equations from continuum mechanics can be used to compute components of required strain measure. Such algorithms can face certain difficulties when discontinuities in the displacement field start to occur due to the formation of one or multiple cracks. These are typical scenarios when testing brittle materials. In this communication the abovementioned problem is addressed where numerical

simulations of the test are employed in synercig combination with the experiment through the inverse analysis. Within this approach the experiment is simulated in order to form a discrepancy function that quantifies the difference between measured displacements and their computed counter parts. The function is further minimized with suitable mathematical programming algorithm in order to find material fracture properties. The proposed approach is tested with reference to the mechanical tests of brittle ceramic materials. Achieved results are rather promising and corroborate the conclusion that the inverse analysis employed in the present context can be a useful tool for assessment of reliable mechanical properties of fracture material. It will be evidenced that in order to yield such result it is sufficient to use only reliable displacements from tested specimen, which are not necessarily directly in the zone of crack opening.

ORL3

Algorithm for automatic insertion of cohesive elements for simulation of brittle materials

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Ceramic materials at high temperature applications often experience complex mechanical behavior with diverse nonlinearities, like viscous effects, irreversible deformation and fracture. Numerical simulation of discontinuities of displacement field provoked by crack openings is rather challenging in that context, given the nonlinear response of surrounding not fractured material. An effective tool for simulating crack openings represents the so-called cohesive elements that can be used both with 2-dimensional and 3-dimensional applications. These elements are surfaceless (i.e. volumeless for 3-D applications) and generally have mechanical behavior that is governed by traction-separation law. While very efficient from a numerical implementation point of view, clearly the major drawback of their practical application consists in constraining the crack to propagate only along previously inserted paths within the model. The contribution of this communication to the above outlined problem consists in developing an automatized two-step algorithm. Within the first step, a continuum model is considered that serves to generate stress distribution based on which it is decided along which directions the cohesive elements should be inserted. The second model is further used to simulate the cracking of the material. In-house built software is developed that generates the second numerical model with cohesive elements starting from data generated from the first one. Presented approach is tested on diverse case studies regarding both linear and non-linear fracture. Obtained results are fairly promising, while the approach seems to be very robust and easily upgradable for diverse failure criteria.

ORL4
Development of thermoplastic constitutive models for refractory ceramics in wide temperature range

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Refractory materials play a crucial role in the steel industry. Research and innovation are fundamental in order to improve design of devices and processes. Lorenzo Fiore's presentation will show the basic equations for the description of the thermo-mechanical modelling of ceramic refractory materials, with a focus on the Bigoni-Piccolroaz yield surface, and the open points for the proper definition of hardening laws for the description of the materials in the whole range of working temperatures.

ORL5
Structural properties of FeCoV alloys produced by PIM / MIM technology

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FeCoV alloys with high saturation magnetization and high Curie temperature, making them useful for high-temperature and power-dense applications (e. g. aviation device). In this study, we report the results of observing the structural properties of 49Fe49Co2V alloy produced by PIM / MIM technology. The starting granulate was prepared by mixing FeCoV powder with a low-viscosity binder. After injection, the raw "green" samples were first treated with a solvent and then thermally with the same aim of removing the binder. MIM technology is completed by high-temperature sintering of "brown" samples for 3.5 hours at temperatures from 1370 ^{O}C to 1460 ^{O}C in a hydrogen atmosphere, which provides the necessary magnetic and mechanical characteristics. Depending on the sintering temperature, structural parameters of particle size D_{max}, Feret X, Feret Y were investigated and analysed.

ORL6

Rapid rate sintering of bulk low-positive thermal expansion material $Al_2W_3O_{12}$ for thermal shock resistance applications

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$A_2M_3O_{12}$-type ceramics may exhibit thermomiotic property, *i.e.*, negative or near-zero thermal expansion coefficients. This unusual property predetermines them for thermal shock resistance applications, among others. However, there are certain challenges related to the reliable, rapid, and low-cost fabrication of $Al_2W_3O_{12}$ defect-free dense bodies. Advanced sintering techniques with added pressure, like spark plasma sintering or hot isostatic pressing, allow decreasing the sintering temperature and lead to lower production, energy and maintenance costs, and better control of the microstructure. Pressureless sintering methods can achieve similar densification but at a cost of using prolonged two-step or three-step sintering. The unconventional pressureless method of rapid rate sintering (RRS), or fast firing, overcomes this drawback while maintaining good densification and microstructure control. In this work, nanopowder $Al_2W_3O_{12}$ synthesized by co-precipitation was densified by the means of RRS. High densification was achieved even when a low sintering temperature of 680 °C, with a 10 min dwell time, was used. The crystalline orthorhombic phase was confirmed by X-ray powder diffraction. The influence of the sintering cycle on properties such as the state of the microstructure, grain size, mechanical properties, coefficients of thermal expansion, and light absorbance is discussed.

ORL7

Hydroxyapatite grafting with alanine amino acid - efficiency of different methods

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Hydroxyapatite (HAp) attracts great attention due to application in reconstructive medicine for hard tissues, mostly bones and teeth, where it is declared to be highly biocompatible material. Its grafting with amino acids further increases biocompatibility and has crucial importance for acceptance of body implants. In this work different methods of grafting were

investigated: simple mixing, thermal treatment induction and *in situ* synthesis/grafting reactions. Two amino acid precursors were separately tested in grafting procedures: pure alanine and alanine methyl ester hydrochloride. The efficiency of grafting was determined based on X-ray powder diffraction (XRPD), Fourier-transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM) and thermal analyses (DSC, TG/DTA) of obtained powders, while complementary UV-VIS spectroscopy of supernatants was additionally performed for quantitative determination of non-grafted nitrogen using ninhydrin standardized procedure.

ORL8

Quantum efficiency of up-converting $SrGd_2O_4$:Yb,Er nanoparticles

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Up-conversion properties of $SrGd_2O_4$ nanoparticles co-doped with different Yb^{3+} and constant Er^{3+} ions were successfully prepared *via* sol- gel assisted combustion. Rietveld refinement and scanning/transmission electron microscopy with corresponding energy-dispersive X-ray spectroscopy revealed that obtained powders are composed of agglomerated nanoparticles with orthorhombic (*Pnma*) structure that have a uniform distribution of all constituting elements. Photoluminescence measurements implied intensification of the up-conversion (UC) emission in the visible part of spectrum with the increase of Yb^{3+} content, which is followed by a significant change in the green to red ratio. Two-photon UC processes are established as a result of Er^{3+} f-f electronic transitions: green emission at 523 and 551 nm ($^2H_{11/2}$, $^4S_{3/2} \rightarrow {}^4I_{15/2}$) as well as a red emission at 661 nm ($^4F_{9/2} \rightarrow {}^4I_{15/2}$). The highest value of absolute quantum efficiency (0.055%) is determined for $SrGd_2O_4$ nanoparticles doped with 0.5 at% of Er^{3+} and co-doped with 5 at% of Yb^{3+} (λ_{exc}=976 nm, power density 200W/cm^2).

ORL9

Electronic structure of silver-bismuth iodide rudorffite nanomaterials studied by synchrotron radiation soft X-ray photoemission spectroscopy

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Silver-bismuth iodide (Ag-Bi-I) rudorffites are chemically stable and non-toxic materials that can act as a possible replacement for methylammonium lead halide perovskites in optoelectronic devices. In this report we will present innovative routes for fabrication of Ag-Bi-I nanomaterials, as well as the results of the investigation of the electronic structure of isolated Ag-Bi-I nanoparticles by soft X-ray aerosol photoemission spectroscopy [1, 2]. Aerosol photoemission spectroscopy allows studies of the electronic structure of submicrometer particles that are free from the influence of a substrate or solvent [1-5]. In this approach the aerosol particles can be produced directly from a solution or a colloidal dispersion, which opens a possibility for investigation of a variety of nanosystems that can be produced by wet chemistry methods. This technique relies on the interaction of focused beam of isolated particles with ionizing radiation under high vacuum conditions. In addition, by using tunable synchrotron radiation as an excitation source it is possible to obtain high-resolution photoelectron spectra in the investigated photoelectron energy range.

ORL10

Thermostable polyurethane composites consisting of bio-based polimer matrix and inorganic mineral reinforcements

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The main goal of this study obtaining a composite material with matrix from a natural resource, reinforced with mineral fillers and fibers to achieve excellent thermal behavior. The polymer matrix was castor oil, strenghtened with carbon and Kevlar fibers, oxamide, aluminium trihydrate (ATH), carbon black and their combinations. The first step was design of the composites, which provides easy processing, optimal curing time and good thermal properties. Regard to this, the maximum amount of reinforcements as well as their combination was taken into account. Cured composites were characterized by uniaxial tensile test and dynamic mechanical thermal analysis (DMTA), while trermal properties were examined using modified oxy-acetylene test. The results of mechanical tests showed that the obtained materials have good tensile strength with sufficient flexibility for stress redistribution, which is necessary when exposed to flame or extreme heat. The addition of reinforcements affected the glass transition temperature, but not significantly in respect to neat castor oil matrix. Modified oxy-acetylene test showed that open flame did not penetrate through the prepared materials due to formation of protective carbonaceous layer with good mechanical integrity. These preliminary results verify the use of such materials in applications where thermal and mechanical durability is required.

ORL11

Al_2O_3-YAG ceramic composite with improved creep resistance

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Comprehensive study on effect of YAG amount on densification, creep resistance and mechanical properties of Al_2O_3-YAG composite pressureless sintered at 1600 ^oC was conducted. The main goal was to optimize the amount of YAG in order to fabricate a composite with improved creep resistance and sufficiently good mechanical properties. The composite was made by mixing a commercially available Al_2O_3 powder with fine YAG powder obtained by glycine-nitrate combustion synthesis. Increased driving force for sintering of fine YAG powder allowed fabrication of dense Al_2O_3-YAG composite containing up to 30 vol% YAG. The presence of YAG was found to be effective in improving creep resistance as well as mechanical properties of Al_2O_3-YAG composite such as hardness and elastic modulus. While fracture strength of the composite can be as high as that of monolithic Al_2O_3 (~ 300 MPa), fracture toughness of composite decreased continuously as the YAG content increased. The decrease was ascribed to transgranular fracture of both YAG and Al_2O_3 grains in samples containing larger amounts of YAG. The proper balance between fracture toughness and creep resistance was found in composite containing 18 vol% YAG which had considerably improved creep resistance accompanied by a relatively small decrease in fracture toughness which reached value of ~ 3 $MPa \cdot m^{1/2}$. Hardness and elastic modulus were found to be 15 GPa and 371 GPa, respectively.

ORL12

Possibilities of usage hazardous waste slag in geopolymer mixtures

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This paper presents the results with the aim of finding useful values of unreactive hazardous waste slag generated by manufacturing heating equipment and its application in geopolymer mixtures. Mixtures were made by using fly ash as a basic binder material, while its replacement was performed with hazardous waste slag. In the paper, fresh and hardened properties of geopolymer mortar mixtures made with fly ash and waste slag whose masses have the following percentage: 100:0, 90:10, 80:20; 70:30, and 60:40. The first fresh characteristics of geopolymers were tested and then samples were cured at the temperature of 95 ºC. Mechanical characterization such as flexural and compressive strength were performed on hardened samples by using the standard procedure of cement mortar mixtures. Mechanical properties indicated that the replacement of fly ash with hazardous waste slag in amounts up to 10% increases the compressive strength of geopolymer while 20% of replacement is considered an acceptable level. It can be concluded that used hazardous waste slag can be

implemented in practice and can be used as a building material, with fly ash replacement in the maximal amount of 20%.

ORL13
Development of thermal shock protocol of experiment of carbon-based refractory materials

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Refractory materials are widely used for various high-temperature applications (iron and steel making, nonferrous metals and cement production, glass). Therefore, it is both important and challenging to characterize properly their thermomechanical behavior, especially at a laboratory scale. This presentation aims to show the primary steps of investigating the thermal shock resistance of flow control refractories used in the steel-making industry. A novel thermal shock resistance protocol of experiment is proposed that permits crack initiation and subsequent characterization. The adopted approach for the experiment is to use induction as a heating source and measure the induced damage by the mean of an extensometer. The preliminary results confirm the feasibility of the test and the ability to control the crack initiation by optimizing the geometry of the specimen.
This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 955944

P1 **26.09.2022 (16.30-17.00 installation), 17.00-18.30 poster session CLUB SASA**

Flat band potentials and photocatalytic activities of alumina/zirconia composite ceramics

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Coupled oxide ceramic materials possess attractive properties, such as high surface areas, tunable pore size and shapes, various crystal structures, and a multitude of compositions, which endow them with potential applications in various areas of science and technology. Among these, porous zirconia-based ceramic materials, which can be considered as semiconductors with high band gap energy of ~5eV, have been the subject of intense research because of the potential new extensive use in photocatalytical degradation of organic pollutants.
In the scope of this study mesoporous coupled alumina/zirconia composites were synthesized via the sol-gel method, followed by heat treatment at 500°C, for 5h. The XRD pattern of composites has shown that the addition of zirconia disrupts the crystallinity of alumina. The composites with higher zirconia content are characterized by peaks of the tetragonal zirconia phase. On the basis of the calculated flat band potentials from Mott-Schottky plots and optical band gaps, the conduction and valence band potentials were estimated for the composite semiconductors. Photocatalytic activity of synthesized samples in the process of degradation of trichlorophenol was obtained and correlated with band potentials and optical properties.

P2

The electrochemical behavior of ion-exchange cu-alumina

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Alumina is often used as a support for various types of catalysts or electrocatalyst. The role of alumina was to provide a stable and large surface area for the active metal or metal oxide. As insulating material with high resistivity, alumina was considered to be electrochemically inactive. However, surface groups in the alumina enable a distinct electrochemical response that greatly depends on the type and the number of surface groups present in different alumina types.
The aim of this study was to investigate the response of different alumina types modified by cooper. Two alumina oxyhydrates with different water content, 3mol H_2O/ mol Al_2O_3 (gibbsite) 0.6 mol H_2O/ mol Al_2O_3 (α,γ-alumina phase), were used in this study. Copper modified alumina samples were prepared by ion exchange with a solution of $CuSO_4*5H_2O$. Cu-alumina samples were dried at at 110 ^oC overnight. The obtained samples were used as modifiers of the carbon paste electrode. Their electrochemical response toward

ferricyanide/ferrocyanide redox probe was evaluated by cyclic voltammetry and correlated with the type of alumina and the amount of copper in impregnated alumina. The possibility of the application of Cu-alumina as an electrochemical sensor was tested.

P3

P-channel power VDMOSFETs under the influence of radiation and static/pulsed NBT stress

Sandra Veljković[1], Nikola Mitrović[1], Snežana Đorić-Veljković[2], Vojkan Davidović[1], Ivica Manić[1], Snežana Golubović[1], Aneta Prijić[1], Zoran Prijić[1], Goran Ristić[1], Danijel Danković[1]

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In this study, the effects of static and pulsed negative bias temperature (NBT) stress on the irradiated commercial p-channel VDMOS transistors are investigated, as well as the effects of radiation on NBT stressed transistors. Also, the relative contributions of gate oxide charge - N_{ot} and interface traps - N_{it} to threshold voltage shifts are researched to further highlight the effects of these stresses on power devices. The static NBT stress interval before irradiation has a slightly higher effect on the radiation response of power VDMOS transistors when irradiation is performed without the gate voltage. In light of the fact that the analyzed components are more likely to operate in the dynamic mode than in the static mode in practice, subsequent investigation focused on the results obtained during a pulsed NBT stress after irradiation. Since only high temperature is applied during the pulse-off state, the effects of N_{ot} neutralization and N_{it} passivation, which are often associated to annealing, are intensified for components subjected to the pulsed NBT stress following irradiation, compared to components subjected to the static NBT stress. It has been noticed that the reduction of the threshold voltage shift during the pulsed NBT stress is considerably greater than during the static NBT stress in devices that have been previously irradiated with the applied gate voltage.

P4

Examination of mineral composition and color origin in natural pigments from France and Finland that are stored in the collection of rocks and minerals, University of Belgrade

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The natural mineral pigments, known as ocher, are stored in The Collection of Rocks and Minerals, Faculty of Mining and Geology, University of Belgrade. Powdered samples of yellow limonite from France (No.421) and red limonite from Finland (No.423) were donated at the end of the XIX century by St. Petersburg Mining Institute. As ocher consists of a mixture of clay minerals, sand and iron oxide/hydroxide, its color depends on the presence of the particular mineral. This work aimed to examine the mineral composition and color of raw and annealed (1000 °C) samples by application of NIR-VIS infrared spectroscopy. Sample No.421 consists of a halloysite-kaolinite clay mixture, with a yellowish-orange (580nm) color that changes to reddish-orange (595nm) after annealing. Sample No.423 consists of kaolinite clay, it is reddish-orange (599nm) in color with a slight change of wavelength after treatment (603nm). Further investigation is needed to determine the influence of chemistry on the final color.

P5

Comparison of raw clay from different localities for application in the production of traditional pottery in Serbia

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In western Serbia, the modelling technique and technological procedure of traditional pottery production still rely on a “slow wheel” combined with the coiling technique while in the eastern parts of Serbia traditional pottery is produced by hand with the help of several wooden and metal tools. The optimal way of making these types of pottery vessels is dictated by the composition of the clay body that is used in the production. By comparison of two raw clay bodies from different localities and based on their mineralogy, obtained by X-ray diffraction, scanning electron microscope and differential thermal analyses, we have gained insight into the process of selection in the production technique characteristic for the specific type of pottery in the investigated regions in Serbia. The obtained information will additionally aid in the preservation of this type of intangible cultural and geo heritage.
Acknowledgement: Contract on realization and financing of scientific research work NIO in 2022, No. 451-03-68/2022-14/200126

P6
Thermodynamic and kinetic study of nicotine adsorption on acid-modified smectite

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Kinetic and thermodynamic parameters of nicotine adsorption onto acid-activated standard Wyoming clay were investigated to obtain the optimum conditions for adsorption. The nicotine adsorptions were performed in a batch system, using 0.75 mM solution of nicotine, the mass of adsorbent of 25 mg at native pH=9.26, in temperature range from 25°C – 60 °C. The pseudo-first (PFO) and pseudo-second kinetics (PSO) models in both linear and non-linear forms were apied for experimental data in the temperature range 25 °C – 60 °C. Error analysis parameters such as correlation coefficient (R^2) and χ^2 (chi-square) have been used to determine the best kinetics interpretations of adsorption data. The analyzed parameters suggested that nicotine adsorption can be best described by tested models in the following order: non-linear PSO = linear PSO >non-linear PFO>linear PFO. The Weber-Morris intra-particle diffusion model was applied in order to predict the rate-limiting step. The calculated values for C_{id} were in the range 0.452 mmol g^{-1} to 0.484 mmol g^{-1}, indicating effective role of the boundary layer on the adsorption rate. Thermodynamic study revealed that nicotine adsorption is spontaneous ($\Delta G°$=-18.93 kJ mol^{-1}) physisorpton process with calculated value of enthalpy change of 4.99 kJ mol^{-1} and activation energy of 21.95 kJ mol^{-1}.
Acknowledgement This work was supported by the Ministry of Education, Science and Technological Development of the Republic of Serbia (Contract 451-03-68/2022-14/200026)

P7
Cobalt impregnated mixed Al, Fe-pillared montmorillonite as a catalyst for decolorization of tartrazine in the reaction with Oxone®

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Mixed Al, Fe pillared clay (AlFePILC) was synthesized from Na-exchanged Wyoming clay (Na-Wy) rich in montmorillonite. In the pillaring process Na-Wy was modified with a mixed intercalating (Al, Fe) solution with molar ratio of $Fe^{3+}/(Al^{3+}+Fe^{3+})$ = 10%. The obtained AlFePILC was impregnated with cobalt using the incipient wetness impregnation method, dried at 110 ºC and calcined at 450 ºC (Co-AlFePILC). Co-AlFePILC was tested as a catalyst in catalytic oxidation of tartrazine in the presence of Oxone®. Decolorization was monitored at wavelength λ=426 nm, while degradation of aryl groups was followed at λ=257 nm using UV-Vis spectroscopy. The influence of the mass of the catalyst on degradation process was

followed in the mass range from 10 mg to 50 mg at 30 °C. It was found that mass increase was beneficial for the decolorization rate. The effect of temperature was investigated from 30 ºC to 60 ºC. The decolorization was over 90% after only 10 minutes for the temperature of 60 ºC, while with the temperature decrease, the decolorization rate decreased. Co-AlFePILC was found to be an efficient catalyst in degradation of tartrazine in the presence of Oxone®.
Acknowledgement: This work was supported by the Ministry of Education, Science and Technological Development of the Republic of Serbia (Contract 451-03-68/2022-14/200026)

P8
Chemical analysis of historical mortars from the Roman period in Serbia

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This work is part of the MoDeCo2000 project research concerning the historical mortars from the Roman period in today's Serbia. It is focused on the chemical analysis of mortar samples selected from archaeological sites along the Danube River. The main compositional and technological features of the mortars were determined by chemical analyses with energy-dispersive x-ray fluorescence (EDXRF) and inductively coupled plasma optical emission spectrometry (ICP-OES) with an HF resistant introductory system. The aim of this study is to present the analytical chemistry strategy used for the rapid and reliable characterisation of the relevant features of historical mortars.
It is concluded that the EDXRF technique can be directly applied to solid samples, but ICP-OES still requires sample decomposition and dissolution to make full use of its analytical capabilities. However, in many cases, ICP-OES includes a quartz introductory system, and hydrofluoric acid removal by treatment with borates must be applied before measurement. Replacing the quartz introductory system with an HF resistant introductory system is achieved to eliminate the neutralisation step with borates, and still get very accurate boron and silicon results.
After detailed research, standard reference certified materials of selected rocks, clays, and limestone (CRM NIST 688 (basalt rock), NCS DC CRM 60102 (clay), NCS DC CRM 60104 (clay), NCS DC CRM 60105 (clay), NCS DC CRM 60106 (clay), BCS-CRM 512 (dolomite), BCS-CRM 513 (limestone)) were analyzed with the same chemical techniques, sighting the identification of potential types of raw materials employed for the production of mortars. Data analysis as a tool of statistics was applied to evaluate the characteristics of mortars, mutually differentiating mortars from different sites, as well as typify updated samples.
The analytical results showed that the EDXRF technique can be used together with other well-established techniques (ICP-OES) and presents a good potential as a reliable, cheap, and fast chemistry strategy to carry out the study of historical building materials. Elaboration of cheap and quick analytical methodology is an important aspect in the development of advanced steps in the research of historical mortars' production technology.
Acknowledgment: This research was supported by the Science Fund of the Republic of Serbia, PROMIS, #6067004, MoDeCo2000.

P9

Surface characterization of aluminum pillared clay-supported cobalt

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Our previous study demonstrated that cobalt content strongly affected the electro-activity of aluminum pillared clay-supported cobalt (CoAP) toward glucose oxidation. It was found that the electro-activity of CoAP increased with the increase of cobalt loading. However, at the 10 wt.% of cobalt content, the electro-activity significantly decreased. In the present study, the focus is on the investigation of the nature of the surface sites that might cause the difference in the electro-activity of CoAP. For this purpose, CoAP with 3 wt.% and 10 wt.% cobalt contents (x%CoAP, x=3 and 10) were characterized using FE-SEM and HR-TEM with EDX techniques, and XPS. The microscopic techniques coupled with EDX have shown that cobalt oxide nanoparticles were evenly distributed in both samples. However, the higher cobalt loading resulted in cobalt oxide agglomeration that led to larger particle sizes. The results of XPS confirmed the presence of Co (II) in the 3%CoAP. On the other hand, the presence of Co_3O_4 which contains both Co (II) and Co (III) was confirmed in 10%CoAP. It is clear from this study that the electro-activity of CoAP strongly depends on the oxidation state of cobalt. However, the effect of agglomeration and cobalt oxide particle sizes cannot be ruled out.
Acknowledgement: This work was financially supported by the Ministry of Education, Science and Technological Development of the Republic of Serbia (Grant No. 451-03-68/2022-14/200026).

P10

Substitution of feldspars and quartz in ceramic batches by the granitic waste in the production of ceramic tiles

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The urge of replacing part of the ceramic batches' formulation recipes is of great environmental importance. This study details the potential of using granitic waste in the production of ceramic tiles. This waste is found in the dimensional stone quarries, belongs to sediments younger than granite, decomposes, and lacks mechanical strength. The material mainly contains feldspar (especially albite) and quartz, a low quantity of micas, and a minor amount of kaolinite. Such materials are considered cost-effective alternatives because they are suitable as fillers and fluxes for ceramic batches.
The study reveals the chemical and mineralogical composition of the granitic waste and composite materials (particle size distribution, XRF, XRD, FT-IR) containing 60 % raw ceramic clay and 40 % granitic waste. In addition, thermal behavior is followed by

DTA/TGA/DTG and dilatometry analyses. Laboratory samples were hydraulically formed and calcined at 1100 and 1200 °C. The microstructure of the samples is recorded by SEM-EDS. The important properties of the semi-industrial probes are tested according to the EN ISO 10545 set of standards, and the tiles are judged to belong to the group that absorbs 0.5 and 3 % of water in a vacuum. The samples were subjected to the standard-defined freeze-thaw tests and found insusceptible and were found to be free of lead and cadmium. Additionally, the L*a*b* color coordinates of the products obtained from clean waste and the composite are displayed.

The convenience of using waste in other ways is sustainable management and an environmentally friendly solution by avoiding landfilling while ensuring the conservation and increased economic benefits of rare natural feldspar deposits.

Acknowledgment: *This investigation is supported by the Serbian Ministry of Education, Science and Technological Development (contract number: 451-03-68/2022-14/200012)*

P11

Using magnesium ferrite catalyst for degradation of acid violet 109 from aqueous solution by heterogeneous Fenton process

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Organic pollutants and their residues formed after various technological processes can be found all around us (in soil, watercourses, and air). The textile wastewaters contain many hazardous substances which have carcinogenic and mutagenic effects on living organisms. The study divides into two parts; the first part is dedicated to the synthesis and characterization of catalysts, and the second part describes the decolorization of AV 109 solution by the heterogeneous Fenton process using magnesium ferrite as a catalyst. The catalysts are synthesized by the sol-gel technique and sintered at different temperatures (500, 600, and 700 °C). Scanning Electron Microscopy reveals the morphological structure of the ferrite-based catalysts, and the size and form of the used catalysts can describe using some shape factors. Elemental analysis of the supported catalyst surfaces revealed by Scanning Energy Dispersive Spectroscopy. The effect of dye's, hydrogen peroxide's and catalyst's concentrations, pH value, and type of catalyst, on dye removal by the Fenton process was studied. The change of AV 109 concentration during the decolorization was followed using the UV-Visible spectrophotometer.

P12

Possibility of using other additives as replacement for air entraining admixture in concrete

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Concrete in which the air entraining admixture was used can exhibit behavior which alternate from the 'standard' concrete behavior when employed in the structural design. The origin of this problem can be found in the changeable properties of the componential materials, incompatibility of the utilized raw materials, influence of extreme conditions on the concrete curing (i.e., increased temperature), etc. The possibility of using other additives for the concrete exposed to various environmental influences was investigated. Sustainability of concrete production and resource efficiency urged the searching for an adequate waste material or an industrial byproduct which would improve freezing/thawing resistance of concrete. In this paper the possibility of Sika Aer Solid powdery additive and recycled rubber as a substitute for the air entraining admixture was investigated. Four mixtures were designed: referent concrete with no air entraining admixtures, concrete with Sika Aer Solid, concrete with recycled rubber, and concrete with air entraining admixture. The properties of fresh and hardened concrete were examined. The obtained results of compressive strength, resistance to freezing/thawing cycles and depth of water penetration under pressure for altered concretes indicate that it is possible to use alternative additives as substitutes for air entraining admixture.

P13

Adsorption of anthraquinone dye acid violet 09 from aqueous solution using synthesized alumina-iron oxide doped particles

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One of the promising methods for wastewater treatment is adsorption. This study investigated the adsorption of anthraquinone dye Acid violet 109 from water solution using the alumina-iron oxide doped particles prepared by sol-gel method and sintered at 800 ℃. The adsorbent

morphology and distribution of diameter of the particles were revealed by Scanning Electron Microscopy and Energy Dispersive Spectroscopy. In the second part, the effect of initial dye's and adsorbent's concentrations and pH value on dye adsorption was studied. Also, the kinetic study of dye adsorption covers the pseudo-second-order and intra-particle diffusion. The change of AV 109 concentration during the adsorption was followed using the UV-Visible spectrophotometer. The adsorption kinetics is in accordance with the pseudo-second-order kinetics model. After 60 minutes of treatment, at the initial dye's concentration of treatment, at the initial dye's concentration of 50 mg dm^{-3} using the alumina-iron doped particles adsorption efficiency was 51.3% and the value of adsorption capacity is 2.64 mg g^{-1}. The adsorption rate was 0.122 g mg^{-1} min^{-1}.

P14

The behavior of cerium doped phosphate tungsten bronze in Briggs-Rauscher oscillatory reaction

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The Briggs-Rauscher (BR) reaction is an oscillating reaction in which the oxidation of malonic acid ($CH_2(COOH)_2$) in the presence of hydrogen peroxide (H_2O_2) and potassium iodate (KIO_3) is catalyzed with a metal ion (usually Mn^{2+}) in acidic aqueous solution. The BR reaction is very sensitive to the addition of different types of analytes. Every change in oscillatory dynamics, caused by analyte addition, can be used for the appraisal of analyte concentration, as well as its potential antiradical or catalytic activity.
The cerium doped phosphate tungsten bronze (Ce-PWB) was obtained by thermal treatment and characterized by TGA, DSC, FTIR, and XRPD technics. In this work, the behavior of Ce-PWB and its influence on BR oscillatory dynamics was examined. Different masses of Ce-PWB (0.0303 g; 0.0400 g; 0.0704 g; 0.1045 g) were added to the BR reaction solution consisting of: $[CH_2(COOH)_2]_0$=0.0789 mol dm^{-3}, $[MnSO_4]_0$=0.00752 mol dm^{-3}, $[HClO_4]_0$=0.03 mol dm^{-3}, $[KIO_3]_0$=0.0752 mol dm^{-3}, and $[H_2O_2]$=1.2 mol dm^{-3} in total volume of 25 ml. The obtained results were compared with the basic BR oscillogram (oscillogram obtained without the addition of Ce-PWB). The results revealed that an increase in the mass of added Ce-PWB has slightly shortened the oscillation time duration with the minimal change in the form of the basic BR oscillogram, suggesting the catalytic effect of this bronze in oscillatory reaction.
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P15

Formation of nitride powders by carbothermal reduction- nitridation of diatomite

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In the synthesis of silicon nitride (Si_3N_4) based powders by carbothermal reduction-nitridation of diatomaceous earth, the effects of addition of silicon nitride powder on the phase composition, particle size and shape were investigated in this paper. Activated carbon was used as carbon sources. In order to obtain better quality Si_3N_4 powder in a faster and more efficient way, α-Si_3N_4 powder was introduced into starting mixtures as seeds. The starting mixtures of diatomaceous earth, carbon source and commercial α-Si_3N_4 powder (5,10,15 and 20 wt.%) were thermally treated at 1350 °C and 1450. X-ray diffraction (XRD), infrared spectroscopy with Fourier transform (FTIR) and scanning electron microscopy (SEM) were employed to characterize the phases, functional groups, microstructure of the obtained powders. The major reduction of diatomaceous earth took place at 1450 °C. At 1350 °C particles retained the morphological characteristics of the starting diatomaceous earth. At 1450 °C, observed particles possess a polygonal habitus, which is characteristic for silicon nitride crystals.

P16

Crosslinking of rare earth ions into aluminosilicate inorganic polymer

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Rare earth oxides have been broadly utilised in different research areas due to their unique properties. This research aims to examine the effect of Nd and Sm in the form of oxide addition in the metakaolin-based geopolymer matrix. Metakaolin-based geopolymers with the addition of different percentages of Sm_2O_3 and Nd_2O_3 (S_1-S_6) were synthesised. Samples contained 0.1% Sm; 1% Sm; 5% Sm, and 0.1% Nd, 1% Nd, and 5% Nd. The focus was on monitoring the polymerisation process using the DRIFT method for 7, 14, 21 and 28 days. The phase composition of the samples was confirmed by the XRD method, while the morphology of the samples was analysed by SEM analysis. After 28 days, due to the polymerisation process, the binding of Neodymium and Samarium ions were incorporated into the structure.

P17
Application of methyl methacrylate for pressing and machining of alumina green ceramics

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The addition of methyl methacrylate (MMA) in the amount of 2 mas% in the alumina mixture improved the pressing of alumina and achieved excellent quality of machining of green compacts. The compressibility test determined the optimal pressing pressure of alumina with MMA of 60 MPa. The value of green densities was analyzed depending on applied pressure up to 150 MPa. The exceptionally smooth and shiny surface of green compact indicates good pressing of alumina with MMA. After pressing, the samples were thermally treated at 115 ^{o}C to activate the side groups of MMA polymer chains at a temperature slightly higher than the glass transition temperature (103 ^{o}C) of PMMA. This way was to improve the strength of the green compact. Compacts prepared with MMA had higher values of green density and lower values of sintered density, total and open porosity than compacts without MMA. After sintering at 1620 ^{o}C, the relative linear shrinkage was about 15% for the entire range of applied pressing pressures. The machining of the green compact enables the precise production of complicated forms of technical ceramics for the needs of many areas of the economy.

P18
Aluminosilicate matrix of alkali activated mixture of metakaolin/fly ash and wood ash/metakaolin

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Presented research related to the structure of a different kind of alumosilicate matrix of alkali activated materials (AAM). Fly ash (FA), wood ash (WA) and metakaolin (MK) were used as a solid precursors of final AAM samples. Synthesis of the AAM was conducted by mixing in a determined ratio solid precursors and an alkali activator (sodium silicate solution, NaOH solutions concentration-4 mol dm^{-3} and 12 mol dm^{-3}). AAM samples were synthesized by a two-component system: MK/FA and WA/MK. The ratio of components MK/FA and WA/MK

was 0.9. The AAM samples were cured at determined laboratory conditions (time, temperature, humidity, aging) in covering mold. The X-ray diffraction (XRD), Diffuse reflectance infrared Fourier transform spectroscopy (DRIFT), and Scanning Electron Microscopy (SEM) were provided to the samples after twenty-eight days of geopolymerization process. The higher background of both MK/FA and WA/MK based AAM samples indicates the achievement of amorphization during the geopolymerization process. In investigated samples, the characteristic stretching asymmetric vibrations C=O, and carbonate vibrations were expected in highly alkaline FA/MK and WA/MK mixture. SEM morphology of all AAM samples noticed an amorphous phase with irregularly distributed, agglomerated particles, and some crystal phases originating from raw materials on the surface alumosilicate matrix.

P19

The influence of preparation procedure on the structure and properties of nanocomposites containing polyurethane/mesoporous silica nanoparticles

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Poly(dimethylsiloxane)-based polyurethanes and their mesoporous silica nanoparticles nanocomposites were prepared by pre-polymer procedure. The materials were prepared in the form of films, consist of 4,4´-methylenediphyl diisocyanate and hyperbranched polyester of the second pseudogeneration as the hard segments, and poly(dimethylsiloxanes) prepolymer as the soft segments. For nanocomposites preparation with equal ratios of the hard and soft segments (50 wt.%), non-functionalized mesoporous silica nanoparticles (MSNs) were used as nanofillers (1 wt.%). The influence of preparation procedure i.e. addition of MSNs before the first phase of polymerization and after the second phase of polymerization on the structure, thermal, nanomechanical and swelling behavior of the prepared materials was studied. Fourier transform infrared (FT-IR) spectroscopy, thermogravimetric analysis (TGA), differential scanning calorimetry (DSC) and swelling behavior were applied for the investigation of the structure and properties of the prepared materials. The microstructure, nanomechanical and thermal properties of nanocomposites are strongly dependent on the preparation method employed. Nanocomposites with improved properties were prepared by adding dispersed MSN nanoparticles after the second phase of polymerization. Due to the improved properties, the prepared nanocomposites can be good candidates as coatings in biomedical applications.

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P20

Polyurethane/nanoferrite composite materials: antifungal and nanomechanical properties

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Crosslinked polyurethanes (PUs) based on hyperbranched polyester and poly(dimethylsiloxane) (PDMS), which are thermosetting polymers, are one of the most representative products in the coating applications. To enhance the biomedical properties of PUs, we have attempted to incorporate PDMS as soft segments and silver-ferrite as nanoparticles in order to prepared PU nanocomposites (PU NCs). Silver ferrite nanoparticles were incorporated into crosslinked polyurethanes (PU NCs) with different soft poly(dimethylsiloxane) segments, via *in situ* polymerization. Herein, we report the nanomechanical properties, hydrophobicity and antifungal activities of PU NCs based on poly(dimethylsiloxane), 4,4'-methylenediphenyl diisocyanate and hyperbranched polyester of the second pseudogeneration, with different soft (PDMS) segment content. The nanomechanical properties of PU NCs were investigated by nanoindentation measurements, while the hydrophobicity of PU NCs was measured by water absorption properties. The fungicidal activities of PU NCs were evaluated against *Candida albicans* and *Candida parapsilosis*. PU NCs with lower soft segment content exhibited selective and good antifungal activity toward the tested fungi due to higher hydrophilicity and higher amount of Ag+ ion released. The selective fungicidal activity and low cytotoxicity of PU NCs with good nanomechanical properties ensure it is a candidate as coatings for medical devices.
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P21

Deviation measurement of SLS PA material regarding location and orientation of printing

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SLS technology is widely used in several industries worldwide mainly due to its ability to manufacture complex geometry components with less effort compared to conventional methods. Such technology uses materials in powder form, the most common ones are polyamides (PA), polystyrenes, thermoplastic elastomers, and polyaryletherketones. Research covers flexural PA12 specimens, with CAD model dimensions selected according to the ISO 178 standard, with 96x8x4 [mm] in bulk. Printing was performed on Fuse 1 (FormLabs, Summerville, MA) machine with four batches, differing in printing orientation and printing location. Vertical and horizontal orientations are applied, and each orientation is combined with the printing location, i.e., in the middle and on the edge of the powder bed. Printed specimens are scanned and obtained scans are then compared with original CAD model in the GOM Inspect program. All four specimen batches have deviation maximum on lateral sides, where the surface is minimal. Nearly 0.42 mm deviations are present in horizontally printed specimens placed in the middle of the powder bed, and these values are maximal recorded deviations. Worth mentioning are vertical specimens printed in the middle, which show not only lateral deviations but posses 0.07 mm deviations on largest surface, i.e., on 96x8 mm one.

P22

Optically active $SrGd_2O_4$ phase: Yb^{3+}/Ho^{3+} and Yb^{3+}/Tm^{3+} co-doping

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Optically active materials have a wide range of applications. The phenomenon of light conversion includes two main types: up-conversion, which is the ability of convertion lower energy photons into the ones with the higher energy, and down-conversion, which is vice versa. Orthorhorhombic $SrGd_2O_4$ doped with rare earth elements is established to have promising optical characteristics, but rarely explored until nowadays as up-converting material. Due to the phonon energy of around 475 cm^{-1}, which is lower than in many other compounds commonly used hosts, this one has a great perspective as an optically active

material. Here, for the first time two combinations of rare earth dopant ions, Yb^{3+}/Ho^{3+} and Yb^{3+}/Tm^{3+}, with different mutual ratios were chosen as pairs for inducing up-conversion. Sol-gel assisted combustion synthesis, which comprises citric acid as chelator and glycine as fuel, was used to obtain powdered samples that are subsequently thermally treated for 3.5 h at 1100°C. X-ray powder diffraction analysis (XRPD) was performed to determine crystal structure. Morphology characteristics were observed by scanning and transmission electron microscopy (SEM/TEM). Photoluminescent up-converting properties were measured in function of laser power (976 nm) in order to define optimal doping concentration and up-conversion mechanism.

P23

Related effects of $Ca_{1-x}Gd_xMnO_3$ (x = 0.05, 0.1, 0.15, 0.2) compound

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We have used theoretical and experimental methods to investigate the octahedral tilting and related effects of $Ca_{1-x}Gd_xMnO_3$ (x=0.05, 0.1, 0.15, 0.2) compound. Both methods have shown that orthorhombic-perovskite structure (space group *Pnma*) is the most stable form and according to Glazer's classification belongs to $a^-b^+a^-$ tilt system. Our bond valence calculations (BVC) have shown ten additional perovskite-related modifications of the equilibrium $Ca_{1-x}Gd_xMnO_3$ structure, and their stability has been investigated as function of Gd doping. We have further studied the influence of gadolinium amount on Mn-O bond angles and distances, tilting of MnO_6 octahedra around all three axes and deformation due to the presence of Jahn-Teller distortion around Mn^{3+} cation, and calculated the amount of Mn^{3+} in the system. The infrared reflection spectra of $Ca_{1-x}Gd_xMnO_3$ samples confirmed XRD results that $Ca_{1-x}Gd_xMnO_3$ nanopowders are of *Pnma*-1 structure and that the tilting of octahedra are increased with Gd doping. The EPR spectra are in accordance with the assumption that EPR linewidth is Mn-O-Mn angle dependent. The studied samples showed that small octahedra tilting in these samples brought only a small change of the EPR linewidth.

P24

Analysis of vascularization markers' expression in ectopic osteogenic constructs in mice

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Bone regenerative medicine faces a number of challenges that need to be adequately addressed in order to heal bone tissue. One of the key issues that must be solved is to achieve proper vascularization. Bone tissue engineering offers a number of promising strategies to overcome this problem. The aim of this research was to analyze vascularization markers expression in ectopic osteogenic constructs. Two types of constructs were prepared. One type was prepared in accordance with the biological triad principle and these constructs contained *in vitro* cultivated mice' adipose-tissue derived mesenchymal stem cells combined with the source of growth factors and loaded onto bioceramic biomaterial as a carrier. The other type of constructs contained bioceramic biomaterial carrier only. Constructs were implanted ectopically and, after one early and one late post-implantation period, explanted and analyzed regarding the relative expression of vascularization marker genes (*Egr1* and *Vcam1*) and immunoexpression of protein markers (CD31 and VEGFR-2). The expression of both gene and protein markers was higher in the constructs enriched with the cells and the source of growth factors. Our results unequivocally show the potential of bioceramic biomaterials enriched with cells and growth factors for application in bone regenerative medicine.
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P25 27.09.2022 (8.30-9.00 installation), 9.00-10.00 poster session CLUB SASA

X-ray diffraction analysis of mechanically activated natural zeolite

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In this research, preliminary investigations of the influence of mechanical energy during the milling process on a sample of natural zeolite were performed. Activation was performed in a mill with a ceramic vessel and ceramic balls for 15, 30 and 60 minutes. The XRD method was used to determine the phase composition. The XRD patterns were obtained on a Philips PW-1710 automated diffractometer using a Cu tube operated at 40 kV and 30 mA. All the XRD measurements were performed at room temperature in a stationary sample holder. Crystallite domain size were calcuclated using SiroQuant v4 software. The mineral composition of the

analyzed sample is as follows: clinoptilolite-heulandite zeolite types, smectite/chlorite minerals, quartz, feldspars, mica, and irregularly interstratified clay minerals. Crystallinity degree of all present phases decreases with activation time in comparison to the non-activated sample. Crystallite domain size for diffration maximum (020) of non-activated sample was 533 Å (FWHM 0.240 o), and decreases with acitivation time to 202 Å (FWHM 0.275 o) for sample activated 60 min.

P26
Adhesion performances of lignin and tannic acid-based bio-epoxy adhesives

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A bio-epoxy surface adhesive for adherence of the wooden component species with desirable adhesion strength was developed with inclusion of bio-based resources, tannic acid and lignin. For the development of bio-epoxy adhesive, the tannic acid was used as cross-linking component, while epoxy functionalized lignin was used for bisphenol A (BPA) replacement. Mechanics, rheological properties, and the possibility of adhered phase de-application were assessed on the bio-substituted samples and compared to commercially available epoxides.
Determination of tensile shear strength of adhesive joints was performed according to SRPS EN 205. Tests were conducted on hydraulic machine for testing of mechanical properties of wood samples "Wood tester WT4", with a measuring scope of 40 kN and at the testing speed of 3 mm/min. Test samples were conditioned at the relative humidity of 65 % ± 5% and temperature of 20 ± 2 ^{o}C, prior to testing and after 7 days in standard atmosphere, they fulfill minimum values of adhesive strength for thin bond lines according to SRPS EN 12765.
Considering our aim, the sample composed of 10 wt.% epoxy functionalized lignin, 70 wt.% BPA thermoset, and 20 wt.% of tannic acid cross-linker was demonstrated to be the most suitable among those analyzed, as it was characterized by reduced BPA content and desired boundary area.

P27

Laser sintered polyamide specimens - fabrication and tensile testing conditions on different geometries

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This work presents the fabrication and tensile testing of polyamide specimens fabricated by selective laser sintering (SLS). Two geometries are considered: SENT (Single Edge Notched Tension) and PRNT (Pipe Ring Notched Tension) specimens. Experimental testing of these specimens is a step in development of a new method for testing of properties of the pipeline materials. The samples were produced by SLS (Selective Laser Sintering) additive production technique. The samples were made from polyamide PA12 on EOS Formiga P100 machine (fabrication parameters: laser power 30 W, print layer height 0.1 mm, scanning speed 1.6-5 m/s, operating temperature 170ºC). Testing was performed in the displacement control on a universal tensile testing machine Shimadzu AGS - X. On this machine, the values of force as well as the values of stress and strain were obtained directly from the Trapezium X software. Special attention in this work is devoted to two important aspects: fixing of the ring specimen for testing and influence of friction between the specimen and the tool. The results obtained on the examined specimens indicate that this study is a valuable contribution for further development and verification of the new fracture resistance testing procedure for different pipeline materials.

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P28
Radiation and pulsed NBTS induced threshold voltage shift in p-channel power VDMOSFETs

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Negative bias temperature instability (NBTI) is one of the critical issues for reliability of metal-oxide-semiconductor field effect transistors (MOSFETs). These instabilities present itself mostly in p-channel MOSFET devices that function under negative gate oxide fields in the range 2-6 MV/cm and at elevated temperatures (100-250°C). Our previous researches were focused on power vertical double diffused MOS (VDMOS) transistors that are part of switching power supply systems. Since these devices are parts of the switching power supply systems, they are exposed to pulsed signals. Power VDMOSFET are also noticed as very sensitive to ionizing irradiation.
Research presented in this paper investigates the effects of pulsed NBT stressing of the commercial power VDMOS device IRF9520 which were previously irradiated with different doses. Parts of the experiment concerning irradiation were performed with the aid of the Metrological Laboratory at the Institute for Nuclear Sciences, Vinča, Serbia, while other parts of the experiments were conducted at the Faculty of Electronic engineering, Niš, Serbia, where special methods for measuring of these effects were developed. Investigation was mostly focused on the threshold voltage shift (ΔV_T) of the VDMOS, since it was shown that this parameter directly affects the device lifetime.

P29
Structural properties of graphene-oxide and its capacity for the elimination of dimethoate from water

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Organophosphate pesticides are known to be some of the most toxic substances synthesized by a man today. Extensive use of this group of compounds in contemporary agriculture results in a critical need for their efficient removal from the environment, especially water. Adsorption of pesticides on different materials is one of the most frequently used strategies for this purpose. In the past decade, the use of graphene-oxide escalated due to its interesting properties.

In this contribution, the adsorption of organophosphate pesticide dimethoate on two commercially available graphene-oxides has been investigated. The materials were characterized by different physico-chemical methods. Careful structural characterization of adsorbents was combined with batch adsorption experiments. It was shown that 1 g of both graphene-oxides is capable of adsorbing 9×10^{-3} mol dm^{-3} of dimethoate at 25 °C. A satisfactory agreement of both sets of experimental results with the Langmuir isotherm model suggests the monolayer adsorption on the homogenous surface. The adsorption was also investigated at 30 and 35 °C. The results showed that the concentration of adsorbed dimethoate increases with temperature for both studied adsorbents. Investigated graphene-oxides were successfully used for the removal of dimethoate from water.

P30
Correlation of the total induced amorphization in SiC crystal with the ion implantation fluence

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During the ion implantation process, regardless if it was attentional or not, amorphization will be introduced into the crystal structure. Depending on the chosen ions, different quantities of the amorphization will be introduced for the same applied fluences. In order to estimate the total amorphization of the SiC crystal for different ions and fluences combination, an assessment model was proposed. For this purpose, 4 MeV carbon and silicon ions with multiple fluences were implanted in the [0001] axial direction of a 6H-SiC single crystal. The amorphization depth distributions were obtained by Elastic Backscattering Spectroscopy/channeling spectra analysis via Channeling SIMulation (CSIM) phenomenological computer code. As a result, relation of the total induced amorphization and implantation fluences for carbon and silicon ions were obtained. Based on these experimental results, a total amorphization assessment model for different ions (energy of 4 MeV) and fluences combination was established.

P31

Fabrication of silver-decorated zinc oxide microrods by hydrothermal method

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We report on hydrothermal synthesis of zinc oxide (ZnO) hexagonal microrods and microtubes. Zinc oxide seeds were deposited onto glass slides by dip coating and used as templates for hydrothermal growth of ZnO microcrystals. The process was carried out in an alkaline reaction medium with acetate and nitrate zinc precursors, using hexamethylene tetramine (HMT) as surfactant. The obtained ZnO microrods were successfully decorated with silver particles via dipping ZnO-containing glass slides in silver nitrate solution and subsequent UV irradiation (5 min). Zinc oxide and Ag/ZnO microparticles were characterized by SEM, EDS and XRD. The presented results are part of the larger concept of developing of anisotropic Ag/ZnO microrods for conversion of chemical to mechanical energy.

P32

Osteogenic process in subcutaneously implanted bioceramic-based scaffolds loaded with glucocorticoid-treated macrophages

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The use of bioceramic biomaterials can be helpful in bone defects healing process, which can be improved by combining biomaterials with specific cells. Macrophages are cells that, depending on their functional state, can significantly influence the outcome of the tissue response to implanted biomaterials and osteogenic process. Macrophages' functional state can be modulated by various agents which can direct macrophages toward pro- or anti-inflammatory state. Glucocorticoids can affect macrophages by directing them to support tissue repair process. The aim of our study was to examine the effect of addition of glucocorticoid-treated macrophages to the bioceramic-based scaffold on the osteogenic process in mice subcutaneous implantation model *in vivo*. For this purpose, implants made of bioceramic-based scaffold, glucocorticoid-treated mice peritoneal macrophages and blood

clot were compared with implants without macrophages (control group). Implants were explanted at different time points, to consider early and late tissue response and osteogenic process, and analysed using histological methods of analyses. The results showed that implants with glucocorticoid-treated macrophages were characterized by good vascularization, good cell-scaffold interaction, presence of osteoblast-like cells and osteon-like structures, as well as preserved cell density. The results indicate that the modulation of macrophage activity by glucocorticoids and their combination with bioceramic biomaterials may be a significant tool in directing the osteogenic process toward a favourable outcome.
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P33
Influence of solution temperature on structural and optical properties of thin flexible copper selenide films obtained by SILAR Method

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A burst of interest in flexible electronics has arisen over the past decade which led to application in displays, solar cells and biomedical sensors. In this work we report the preparation as well as characterization of electrically conductive copper selenide coated polyamide. Thin copper selenide films were synthesized using the successive ionic layer adsorption and reaction (SILAR) method at three different temperatures. It was found that elevating the temperature of the solution led to the creation of copper selenide films with different features. The structural characterization, obtained with X-ray diffraction, revealed that the films grew into a cubic $Cu_{2-x}Se$, but with different crystallinity parameters. The formation of $Cu_{2-x}Se$ was confirmed by Raman measurements. Surface analysis of this films was undertaken by using Scanning Electron Microscopy and Atomic Force Microscopy. Direct band gap values were estimated with help of UV-VIS spectroscopy. Our results suggest that elevated temperatures prevent large agglomeration which leads to higher resistance behavior.

P34

Magnesium substituted hydroxyapatite for biomedical application

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As magnesium is an important trace element in bone and teeth, and plays a key role in bone metabolism, the aim of this study was to obtain magnesium substituted hydroxyapatite (Mg-HAP) and to assess its application potential.
Upon synthesis, the changes in local structure and composition after irradiation and immersion in physiological solution and simulated fluid were followed by electron paramagnetic resonance (EPR) spectroscopy. Samples were also characterized by XRD, FTIR, SEM, EDS, AAS and TGA.
The results showed that irradiation did not affect the composition and structure of Mg-HAP. After immersion in model media, the small amount of by-product of synthesis disappeared already after 24 h and Mg-HAP remained as the only phase. Also, the radical signals in EPR spectra faded or completely disappeared after 28 days in model media, which could indicate that the structure and composition of Mg-HAP both went through a kind of stabilization in conditions mimicking physiological ones. All these indicate that investigated Mg-HAP has good potential for biomedical application considering its behaviour in model media which imitate physiological conditions.

P35

ZnO-based composite materials with improved photo(electro) catalytic properties

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Conversion of solar energy into hydrogen energy via the water-splitting process, assisted by photo-semiconductor catalysts, is one of the most promising technologies for the future because large quantities of hydrogen can be generated in a clean and sustainable manner. Zinc oxide (ZnO) represents one of the most investigated photocatalyst. Its ability to overcome the limitations of pristine ZnO through enhanced visible light absorption and reduced recombination of photogenerated charge carriers have gathered the attention of the many research groups. Numerous studies enabled understanding its greater activities and most studies reveal that reactive oxygen species (ROS), oxygen vacancies (O_v) and zinc interstitials (Zn_i) are responsible for the enhanced photoactivity. In fact, different factors like defect

concentration, defect location, valence and conduction band levels play a key role in the working mechanisms of ZnO material. Materials with the perovskite crystal structure such as $BaTiO_3$ (BT) and $BaTi_{1-X}Sn_XO_3$ (BTS) found application in the construction of the active layer of the solar cell, in which the photogenerative electrons are generated. The environmental instability of perovskite solar cells caused by the ultraviolet photocatalytic effect of metal oxide layers is a critical issue that must be solved. Possible solution with improved environmental stability can be synthesis of ZnO composite heterojunction perovskite solar cells.
In this study photo(electro) catalytic properties of: BT and BTS were compared with those of ZnO@BT and ZnO@BTS, respectively. In both cases the ZnO@BT and ZnO@BTS composite materials revealed enhanced photo(electro) catalytic activity as compared to the pristine BT and BTS materials. In order to investigate the origin of the enhancement, the pristine metal oxides and composites were characterized using a variety of techniques, including X-ray diffraction (XRD), Raman, Fourier transform infrared spectroscopy (FTIR), field emission scanning electron microscopy (FE SEM), UV-Vis diffuse reflectance spectroscopy and linear voltammetry process.

P36

Nanoparticle synthesis in microreactors

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Microreactors are microfluidic devices with a network of channels where chemical reactions can take place. The diameter of those channels is less than 1 millimeter. Advances of such devices are reduction of the time required for the synthesis, better control of the reaction and the size of nanoparticles. There are different materials from which microreactors can be fabricated. The most common are silicon (Si), polymers, glass, ceramics and metals. In this study, we used Si/Pyrex glass and poly(dimethylsiloxane) (PDMS) materials to fabricate two types of microreactors. Both types of microreactors had integrated heaters but different length and width of microchannels. Reaction was performed on the same temperature (80ºC) and with the same reaction time in both microreactors. Synthesis of titanium (IV)-oxide nanoparticles was performed in these microreactors, in order to show how dimension of microchannels can affect the size of nanoparticles. Size distribution of nanoparticles was determined with dynamic light scattering (DLS). It was concluded that dimensions of microchannels had great influence on the size of the nanoparticles.
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P37

Preparation of poly(dimethylsiloxane)-based materials for laser-induced graphenization

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Laser induced graphenization (LIG) of polymer materials has recognized as the most promising method for fabrication of flexible electronic devices. Poly(dimethylsiloxane) (PDMS) is suitable elastomeric materials for flexible electronics devices fabrication due to outstanding mechanical and optical properties. Namely, the low carbon content and the lacking aromatic structures in PDMS material limit the graphenization process resulting in limited conduction properties. The aim of this study was the graphenization of PDMS and PDMS-based materials by CO_2 laser radiation. We prepared pure PDMS elastomer, PDMS/ethylene glycol and PDMS/Triton composite materials by using 20 wt. % of ethylene glycol or Triton in PDMS matrix. Indeed, up to now the evidence of graphenization of these PDMS-based materials has never been observed. PDMS elastomer was prepared by hydrosilylation reaction, while composite materials by blending method. The prepared PDMS-based materials were characterized by Fourier-transform infrared spectroscopy (FTIR), atomic force microscopy (AFM) and Raman spectroscopy. The obtained results showed that surfaces of pure PDMS elastomer and PDMS/ethylene glycol composite cannot be graphenized by direct laser writing. However, by adding Triton as aromatic and carbon sources into the PDMS matrix it is possible to improve the graphenization of PDMS based materials and this material is good candidate for fabrication of flexible electrodes.

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P38

Effect of high energy ball milling on sintering of $MgO\text{-}TiO_2$ system

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Perovskite ceramic material based on $MgTiO_3$ is used in various types of electronic devices owing to its dielectric properties, high dielectric constant, and low losses. These features can be tailored by setting preparation conditions. Densification of magnesium titanate by Spark Plasma Sintering (SPS) was the aim of this work. First, the mechanical activation in the high-energy ball mill was applied on the powder of $MgO\text{-}TiO_2$ mixed in mole ratio 1:1. Prepared powder mixtures, activated for different times, were SPS sintered, at 1200 ^oC with a heating rate of 100^oC/min. After reaching the desired temperature, a uniaxial pressure of 50 MPa was applied, and dwelled at this condition for 5 min, followed by cooling to room temperature at 5^oC/min. The starting powders, activated mixtures, and sintered ceramics bodies were investigated by X-ray diffraction, scanning electron microscopy (SEM), and energy dispersive spectroscopy (EDS). The presence of the $MgTi_2O_5$ phase was noticed for the non-milled ceramics. In the samples obtained from milled powders, $MgTi_2O_5$ was detected in EDS spectra in a lower amount, below the threshold of the XRD method. Dielectric measurements were performed at a wide range of frequencies and temperatures. The highest value of the hardness was obtained from powder milled for 15 min before SPS.

P39

The influence of blood components as additives to implants on their regenerative properties.

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Blood components such as blood clot, blood plasma, PRP (Platelet Rich Plasma), PRF (Platelet Rich Fibrin) and monocytes, when added to implants have been shown to modulate

implant biofunctionality and tissue response. This is an overview of our research on the influence of blood and blood components on the osteogenic characteristics of implants made of bone substitute material (BSM) and the response of surrounding tissue in mice subcutaneous implantation model based on the gene expression, histological analysis, morphometry, immunomarkers, etc. We found that adding blood to BSM can affect its regenerative potential and tissue response. It was shown that bone marrow included in the blood clot can have a stimulating effect on the osteoreparative process and that macrophages added to blood clot have a beneficial effect on the process of angiogenesis and the formation of the bone matrix. It was found that the sub-physiological count of platelets in PRP in combination with BSM shows significant osteogenic potential. When adipose-derived mesenchymal stem cells, differentiated into osteogenic and endothelial cells, but also as freshly isolated stromal vascular fraction are mixed with PRP on BSM carrier, a significant angiogenic and osteogenic capacity was found. Research on orthotopic animal models also showed that addition of blood components to the implants was beneficial for bone regeneration but further studies in that direction prior to clinical application should be performed.

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P40

Coating of bioceramic materials with hyaluronic acid using different techniques leads to different tissue response *in vivo*

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One of the main factors that should be taken into consideration when designing biomaterials for regenerative purposes is the initial tissue response to implanted material. In order to avoid an excessive inflammatory response, especially to degradable and resorbable biomaterials, bioactive agents with anti-inflammatory properties are increasingly used for coating. Our aim was to modify biphasic calcium phosphate (BCP) particles by coating with hyaluronic acid (HA), glycosaminoglycan with proven anti-inflammatory and regenerative properties. We applied two different approaches for coating of BCP particles with HA: 1) covalent immobilization and 2) multilayered coating using layer-by-layer (LbL) technique. Differently coated and uncoated BCP particles were subcutaneously implanted into mice to analyze and compare tissue response, potential anti-inflammatory properties and particles' behavior *in vivo*. Histological and molecular analyses in explanted implants were performed 15 and 30 days after implantation. Characterization of coated BCP particles showed that both approaches were successful in coating of BCP particles with HA. The course of tissue reaction was shown to be dependent on the coating method used. Differences in gene

expression pattern and infiltrated tissue composition were observed between covalent and LbL coated BCP particles but also between coated compared to uncoated BCP particles in examined time points. This suggests that both approaches may be used for coating of biomaterials with aim to modulate and guide the biomaterial-induced tissue response and regenerative processes.

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Characteristic of photodiode based on vanadium oxide-TiO_2 nanotubes/$CH_3NH_3PbI_3$

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The aim of this study was to investigate the influence of the deposition of vanadium oxide epitaxial layer on the photoresponse of $TiO_2/CH_3NH_3PbI_3$ heterojunction. TiO_2 nanotube array was synthesized via anodization of titanium foil at three different voltages. After annealing at 450 °C, vanadium oxide was deposited by direct deposition from vanadyl(IV) sulfate solution. Microstructure analysis has been used for the investigation of the influence of different voltages of anodization on tube diameter. Spectroscopy measurements pointed out the red shift in diffusion reflectance spectra after deposition of vanadium oxide. The presence of V^{5+} oxidation state has been detected on the surface of nanotube arrays by chemical analysis. $CH_3NH_3PbI_3$ monocrystal was dry pressed on top of the nanotubes in order to make a photodiode. The current-voltage characteristics of the photodiode were recorded and it was observed that the sample with the smallest wall thickness and higher amount of vanadium has the best photocurrent response.

P42

Piezoelectric And Pyroelectric Properties Of Fe/Pb/Zr-co-doped Barium Titanate Ceramics

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Powdery mixtures of 50 mass% Fe, 4 mass% Pb, 3 mass% Zr and 43 mass% $BaTiO_3$ were mechanochemically activated via planetary ball mill for time periods spanning from 30 min to 300 min and subsequently sintered for 2 hours at 1200 °C in the dynamic atmosphere of air. Of all the samples, the one activated for 270 min exibited the most prominent piezoelectric effect of up to 1.17 mV under the applied pressure of 113 kPa with the relaxation time of 85 s. The pressure dependence of voltage showed three successive, distinct domains in which the voltage rise differed, with the rate of 0.09 mV/kPa in the initial one (ranging from 0.00 kPa to 5.66 kPa of the external pressure), 0.01 mV/kPa in the second one (from 5.66 kPa to 56.60 kPa) and ultimately the plateau occuring from approximately 60 kPa onwards. When heated to 200 °C, the same sample manifested the biggest pyroelectric effect as well, being 0.55 mV with no external field applied, as well as 1.04 mV when subjected to the homogenous magnetic field of 50 kA/m, thus yielding a 89% net increase of the incited voltage observed.

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Development of thermoelastic transmission conditions across a thin interface

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Refractory devices composed of ceramics are employed wherever there is contact with molten metals as in crucibles filters, furnaces or systems for flow control. The mechanical properties of these materials are very different from metals. The presentation focuses on basic equations related to thermal and mechanical transmission conditions across an interface between two different materials. These equations are linked to the development of material instabilities and crack propagation within the ceramics, in the view of application to refractories operating at high-temperature conditions in steel plants.

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Visible Light Driven Photocatalytic TiO_2-based Nanocomposite Suspensions

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In order to invent an efficient self-cleaning solution for inner spaces, the aim of this research was to develop a pure visible light driven photocatalytic suspension which can be applied onto interior walls and wall paints. For this purpose, layered double hydroxides (LDH), known as materials suitable for carrying certain active functional molecules, were used to carry metal-doped TiO_2. As titania is a very good photocatalyst, although active only in the UV region, doping with transition metals molybdenum and tungsten was used for the reduction of the band-gap energy. Series of molybdenum doped and tungsten doped TiO_2-ZnAl-LDH suspensions were synthesized using a modified low supersaturation co-precipitation method at the optimal pH value of 8.
Detailed material characterization studies by means of scanning and transmission electron microscopy (SEM/TEM), thermogravimetry (TG), dynamic scanning calorimetry (DSC), X-ray diffraction (XRD) and Fourier-transform infrared spectroscopy (FTIR) were performed. The photocatalytic self-cleaning properties of the optimally synthesized TiO_2 doped LDH suspension were assessed when applied on stone, brick, and glass substrates after having been illuminated only by using LED visible light. They were subsequently compared to the properties of commercially available self-cleaning solutions for application on mineral substrates.
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Synthesis and characterisation of cordierite - based protective coating

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The paper investigates the composition and procedures for the production of refractory coatings based on cordierite for the protection of parts of equipment in metallurgy and mining. An ultrasonic vibration method with a stationary sample according to the ASTM G32 standard was used to determine the resistance properties of the obtained protective coatings. The aim of the study was to determine the quality of coatings and the possibility of application for the protection of metal surfaces in conditions of cavitation, wear and corrosion. The change in the mass of the samples as a function of cavitation time was monitored. Cavitation velocity was determined as an indicator of coating resistance under cavitation loads. The occurrence and development of coating surface damage were monitored using a scanning electron microscope. Based on the value of cavitation velocity and analysis of surface damage morphology, cavitation resistance of the coating was determined. The results showed a satisfactory degree of resistance to cavitation of the tested refractory coatings based on cordierite and the possibility of their application for the protection of parts of equipment that will be exposed to cavitation loads during exploitation.

P46

Application of pyrophyllite in building and refractory ceramic materials

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Phyllosilicate mineral pyrophyllite possesses talc's characteristic softness and crystalline structure, but it also exhibits high refractoriness. Pyrophyllite is predominantly being used in the ceramic materials (tiles, porcelain) as a replacement of quartz, clay or feldspar. Due to its thermal transformation into mullite, pyrophyllite is stable at elevated temperatures. Its ion-exchanging properties are crucial for stabilization of the toxic elements in building materials. In this study pyrophyllite is used as a mineral additive for two types of construction products: traditional ceramic materials and refractory mortars. The experimental samples were prepared using 50 % of pyrophyllite and 50 % of refractory clay, ceramic clay, and carbonate brick clay, respectively. The samples were formed into discs or tiles using the compression method. The following characteristics have been investigated: resistance to firing (900 – 1300°C), carbonate content, plasticity coefficient, dimensional changes after drying at 105°C and upon

firing, water absorption, and mechanical strength. Refractory samples were prepared using andalusite as aggregate, ordinary Portland cement and/or high aluminate cement as binder, and pyrophyllite as an additive (10 %, 20 %, and 30 %). Compressive and flexural strength both at normal and at elevated temperature were tested on the samples, along with the refractoriness. The changes that pyrophyllite addition brings to the material's mineral composition, microstructure, as well as to bonding/sintering mechanisms were monitored using instrumental techniques (DTA, TGA, XRD). The aim of the investigation was to prove potential suitability of pyrophyllite as efficient and sustainable resource for the production of ceramic and refractory materials.

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Possibility of obtaining magnesium titanate by mechanochemical process in a high-energy vibro mill

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In order to investigate the possibility of obtaining magnesium titanate, oxides of magnesium and titanium were mechanochemically activated. Mechanical activation was performed for 1000 min in a high-energy vibro mill (engine power is 0.8 kV). The optimal amount of powder activated in the mill is 50-100 g, so according to the stoichiometric calculation, the composition of the starting mixture was 20.2 g (0.5 mol) MgO and 39.9 g (0.5). mol) TiO_2. X-ray diffraction analysis of samples taken from the reaction system was performed after 60, 180, 330 and 1000 min of mechanical activation. Atomic absorption spectrophotometry was used to analyze the current chemical composition of the system, depending on the time of activation. Based on the results of X - ray diffraction analysis, it can be concluded that the greatest changes in the system occurred at the very beginning of mechanical activation due to disruption of the crystal structure of the initial components. X-ray diffraction analysis of the sample after 1000 min of activation showed complete amorphization of the mixture, but no diffraction maxima characteristic of magnesium titanate was identified. Therefore, the mechanical activation experiments were stopped. The fact is that the invested energy was not enough to overcome the energy barrier for the formation of a new chemical compound - magnesium titanate. The inability to synthesize magnesium titanate is explained by the low negative Gibbs energy value of -25.8 kJ / mol (despite the theoretical possibility that the reaction will occur), as well as the amount of mechanical energy that entered the system during activation that is insufficient to obtain the reaction product. Although the synthesis of $MgTiO_3$ has not been achieved, significant results have been obtained that identify models for further research into the possibility of mechanochemical reactions of alkaline earth metals and titanium dioxide.

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Investigation of the possibility of application of mechanochemically activated sodium carbonate in environmental protection

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There is a growing problem in the world of eliminating carbon dioxide and the atmosphere, which leads to the greenhouse effect, and causes a constant increase in the average temperature on Earth. Cutting large green areas in order to obtain space for cattle breeding is especially present in Brazil and Argentina. Increasing CO_2 concentrations and rising air temperatures are leading to the melting of large ice masses causing rising sea levels. That is why the issue of eliminating carbon dioxide from the air is a priority in environmental protection. Sodium carbonate samples were activated for 1 to 28 minutes in a vibro mill. The increase in the free surface area of the activated samples was monitored by the BET method, and the state of the crystal lattice by the diffraction method. The analysis of the results showed a significant increase in the free surface of the activated material as well as significant changes in the crystal structure of the samples due to grinding in a vibro mill. Such activation of sodium carbonate would enable a significant increase in the sorption properties of sodium carbonate and its application.

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The evaluation of mixed Al,Co pillared catalyst in degradation of tartrazine dye in presence of peroxymonosulfate

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In this work smectite pillared with mixture of aluminium and cobalt poly(hydroxo metal) cations (Al,Co-PILC) was synthesized and tested as catalyst in degradation of food dye tartrazine by peroxymonosulfate. The Al,Co-PILC was obtained using a common procedure consisting of the following steps: grinding, sieving, Na exchange, intercalation, drying and calcination. Co^{2+} to (Al^{3+}+Co^{2+}) molar ratios in the pillaring solution was 10%. Catalytic tests were carried out in a semibatch reactor under stirring and constant temperature maintained by circulation of thermostatic fluid using Julabo MC 4 heating circulator. Initial dye concentration was 50 ppm in the presence of excess of peroxymonosulfate. Decolorization of tartrazine solution was monitored using UV-Vis spectrophotometry at λ_{max}= 426 nm. The influence of the mass of the catalyst and reaction temperature was investigated.
Catalyst mass and temperature increase were beneficial for dye degradation rate. The catalytic process at 30 ºC reached 97% for 120 min and besides decolorization included further degradation of products of tartrazine oxidation. At 50 ºC complete decolorization occurred for only 30 min. This work showed that application of smectite pillared with mixture of

aluminium and cobalt poly(hydroxo metal) cations as peroxymonosulfate activators for degradation of water pollutants is very promising.

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