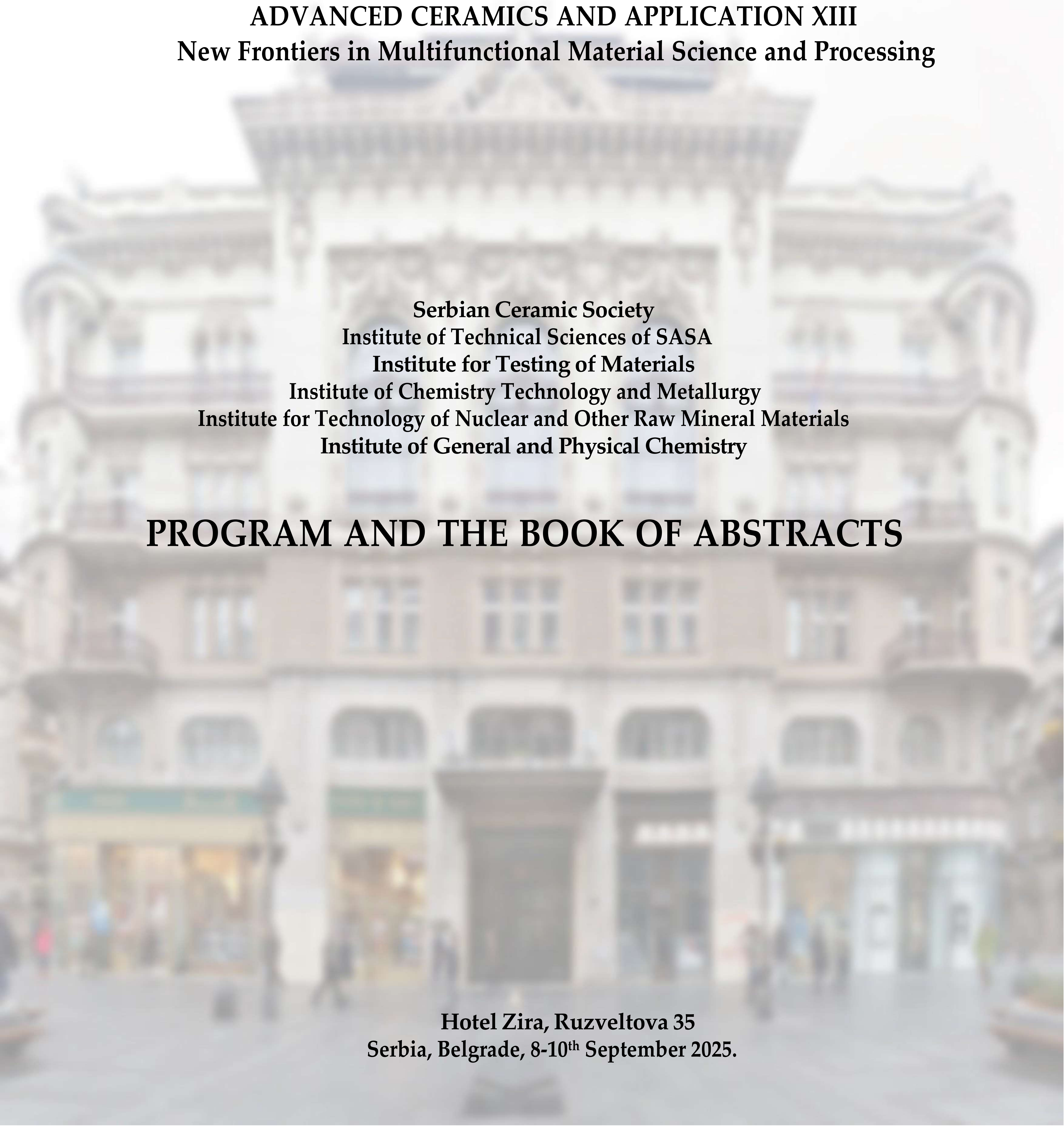

Serbian Ceramic Society Conference
ADVANCED CERAMICS AND APPLICATION XIII
New Frontiers in Multifunctional Material Science and Processing

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
Institute of General and Physical Chemistry

PROGRAM AND THE BOOK OF ABSTRACTS

Hotel Zira, Ruzveltova 35
Serbia, Belgrade, 8-10th September 2025.

Serbian Ceramic Society Conference
ADVANCED CERAMICS AND APPLICATION XIII
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
Institute for General and Physical Chemistry

PROGRAM AND THE BOOK OF ABSTRACTS

Hotel Zira, Ruzveltova 35
Serbia, Belgrade, 8-10th September 2025.

Book title: Serbian Ceramic Society Conference - ADVANCED CERAMICS AND APPLICATION XIII Program and the Book of Abstracts

Publisher:
Serbian Ceramic Society

Editors:
Dr. Nina Obradović
Dr. Lidija Mančić

Technical Editors:
Dr. Nina Obradović
Dr. Adriana Peleš Tadić

Printing:
Serbian Ceramic Society, Belgrade, 2025.

Edition:
120 copies

CIP - Каталогизација у публикацији Народна библиотека Србије, Београд

666.3/.7(048)
66.017/.018(048)

SRPSKO keramičko društvo. Conference Advanced Ceramics and Application : New Frontiers in Multifunctional Material Science and Processing (13 ; 2025 ; Beograd)

Program ; and the Book of abstracts / Serbian Ceramic Society Conference Advanced Ceramics and Application XIII New Frontiers in Multifunctional Material Science and Processing, Serbia, Belgrade, 8-10th September 2025. ; [editors Nina Obradović, Lidija Mančić]. - Belgrade : Serbian Ceramic Society, 2025 (Belgrade : Serbian Ceramic Society). - 112 str. ; 28 cm

Tiraž 120.

ISBN 978-86-905714-2-0

a) Керамика -- Апстракти b) Наука о материјалима -- Апстракти

COBISS.SR-ID 172848905

Dear colleagues and friends,

We have great pleasure to welcome you to the Advanced Ceramic and Application XIII 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, Institute for Testing of Materials and Institute for General and Physical Chemistry.

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. 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. Thanks to all of you for being with us here at ACA XIII.

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:

Dr. Nina Obradović
Dr. Lidija Mančić

Scientific Committee

Academician Antonije Đorđević
Academician Zoran Popović
Academician Velimir Radmilović
Dr. Nina Obradović
Dr. Lidija Mančić
Prof. Dr. Wei Pan
Prof. Dr. Reuben Jin-Ru Hwu
Prof. Dr. Hans Fecht
Prof. Dr. Vladimir Pavlović
Prof. Dr. Bojan Marinković
Dr. Takashi Goto
Dr. Steven Tidrow
Prof. Dr. Zoran Nikolić
Dr. Nebojša Romčević
Dr. Zorica Lazarević
Dr. Aleksandra Milutinović–Nikolić
Dr. Predrag Banković
Dr. Zorica Mojović
Dr. Nataša Jović Jovičić
Prof. Dr. Branislav Vlahović
Prof. Dr. Vera Pavlović
Prof. Dr. Nebojša Mitrović
Dr. Suzana Filipović
Dr. Darko Kosanović

Organizing Committee

Dr. Nina Obradović
Dr. Lidija Mančić
Prof. Dr. Wei Pan
Dr. Smilja Marković
Dr. Ivana Dinić
Dr. Marina Vuković
Dr. Suzana Filipović
Dr. Anja Terzić
Dr. Milica Vasić
Dr. Maja Pagnacco
Prof. Dr. Nebojša Mitrović
Prof. Dr. Vladimir Pavlović
Prof. Dr. Vesna Paunović
Dr. Milica Marčeta Kaninski
Dr. Darko Kosanović
Dr. Jelena Vujančević
Dr. Jelena Živojinović
Dr. Adriana Peleš Tadić
Dr. Milica Vujković
Dr. Dubravka Milovanović
Dr. Nenad Tadić
Dr. Stanko Aleksić
Dr. Isaak Trajković

Sponsors:

Analysis - Lab equipment, Institut MOL,
Turistička organizacija Beograda,
Institut tehničkih nauka SANU,
Institut za ispitivanje materijala,
Institut za tehnologiju nuklearnih i drugih mineralnih sirovina
Shanghai Chenhua Science Technology Corp. Ltd.

ANALYSIS LABORATORY EQUIPMENT

Туристичка организација Београда Tourist Organization of Belgrade

ITNMS INSTITUT ZA TEHNOLOGIJU NUKLEARNIH I DRUGIH MINERALNIH SIROVINA

CHEN HUA

ИНСТИТУТ ИМС IMS INSTITUTE

Institute of Technical Sciences of SASA

Acknowledgements:

Ministry of Science, Technological Development and Innovations RS
Institute of Technical Sciences of SASA
Hotel Zira

Република Србија
МИНИСТАРСТВО НАУКЕ,
ТЕХНОЛОШКОГ РАЗВОЈА И
ИНОВАЦИЈА

Institut tehničkih nauka
SANU

Conference Program and Abstracts

Program and Abstract's Contents

Book of Abstracts

The Thirteen Serbian Ceramic Society 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: Hotel Zira, Ruzveltova Str. 35, Belgrade, Serbia.

Dress code: 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.

Conference fee: Standard fee for foreign participants: *600 EUR*; Standard fee for domestic participants: *20.000 RSD*; **Discounts**: Members of SCS, Plenary lectures and PhD Students: *50%*; Invited lectures: *25%*, and 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 for the conference fee and Gala dinner at site will be available only in cash
Registration:

08-10.09.2025. (8.00-9.00 A.M.-2nd Floor)

Posters installation:

08.09.2025. (8.00-9.00) & 09.09.2025. (8.00-9.00) Mikonos Hall

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 117.2 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** and **Tribology and Materials.**

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 Zira, Ruzveltova Str. 35; http://zirahotels.com/

Tourist Information Centre: Kneza Mihaila 5, http://www.tob.rs/en

Date	Time	Programme	Floor, Room, Address
8th September Monday	**08.00-09.00**	**Registration and Poster*/Exhibition Installation**	Hotel Zira 2nd Floor
	09.00-09.30	**Opening Ceremony**	Mikonos Hall
	09.30-10.00	Academician S. Vukosavić (PL1)	
	10.00-10.15	**Award, Photo session & Short break**	
	10.15-12.15	**Basic ceramic and Sintering (S. Filipović and J. Živojinović)** Wei Pan (PL2) Dušan Galusek (PL3) Laura Silvestroni (INV1) Tamas Csanadi (INV2) Ana Feltrin (INV3)	
	12.15-12.30	**Coffee Break**	Hallway
	12.30-14.35	**Basic ceramic and Sintering (D. Kosanović and A. Peleš Tadić)** Shiwei Wang (PL4) Antonio Vinci (INV4) Jeremy Watts (INV5) Ana Stanković (INV6) Yue Zhou (INV7) Lujia Han (OR1)	Mikonos Hall
	14.35-15.30	**Buffet Lunch**	Restaurant Zira
	15.30-17.30	**Renewable Energy and Composites (M. Marčeta Kaninski and D. Milovanović)** Jasna Janković (PL5) Zulfiqar Khan (PL6) Dragana Vasić Aničijević (INV8) Aleksandra Šaponjić (INV9) Slađana Maslovara (INV10)	Mikonos Hall
	17.30-18.30	**Poster Session I & Exhibition**	Mikonos Hall
	19.00-23.30	**Conference dinner**	Rodos Hall Hotel Zira
9th September Tuesday	**08.00-09.00**	**Registration and Poster Installation****	Hotel Zira 2nd Floor
	09.00-11.20	**Nano, Opto and Bio-ceramics (L. Mančić and I. Dinić)** Anita Grozdanov (PL7) Lei Miao (PL8) Youfu Zhou (PL9) Catherine Johnson (PL10) Smilja Marković (INV11)	Mikonos Hall
	11.20-11.45	**Coffee Break**	Hallway
	11.45-14.05	**Nano, Opto and Bio-ceramics (S. Marković and M. Vuković)** Miladin Radović (PL11) Jianfeng Yang (PL12) Hong Lin (PL13) Huang Zhenying (PL14) Katarina Drdlikova (INV12)	Mikonos Hall
	14.05-15.00	**Buffet Lunch**	Restaurant Zira
	15.00-17.10	**Glass and Electro/Amorphous and Magnetic (N. Mitrović and V. Paunović)** Jing-Feng Li (PL15) Jianguo Zhu (PL16) Guorong Li (PL17) Igor Jovanović (INV13) Charmayne Lonergan (INV14)	Mikonos Hall
	17.15-18.15	**Poster Session II**	Mikonos Hall
	18.45-20.00	**Nikola Tesla Museum**	Krunska 51

08.00-09.00 Poster Session I (Posters 1-23)** * 08.00-09.00 Poster Session II (Posters 24-48)**

10th September Wednesday	**08.00-09.00**	**Registration**	Hallway
	09.00-11.10	**Electrocemistry and Catalysis (M. Pagnacco and M. Vujković)** Branimir Grgur (PL18) Igor Pašti (PL19) Bojan Božić (PL20) Dimitrije Mara (INV15) Nebojša Begović (INV16)	Mikonos Hall
	11.10-11.30	**Coffee Break**	Hallway
	11.30-13.55	**Electrocemistry and Catalysis/Modelling (M. Pagnacco and M. Vujković)** Na Ni (PL21) Branislav Stankovć (INV17) Jelena Senćanski (INV18) Miloš Milović (INV19) Gordana Stevanović (OR2) Nenad Mitrović (INV20) Ilija Stefanović (INV21)	Mikonos Hall
	14.00-15.00	**Buffet Lunch**	Zira Restaurant
	08.30-11.00	**Nano, Opto and Bio-ceramics (L. Mančić and S. Marković)** Jiang Li (PL22) Jianqiang Li (PL23) Marko Spasenović (INV22) Steva Lević (INV23) Beiying Zhou (INV24) Jelena Lazović (OR3) Maxim Ivanov (OR4)	Santorini Hall
	11.00-11.30	**Coffee Break**	Hallway
	11.30-13.50	**Refractory, Clay and Cements/Modelling (A. Terzić and M. Vasić)** Ivanka Netinger Grubeša (PL24) Kaiqi Liu (PL25) Milica Vasić (INV25) Stevan Stupar (INV26) Monika Michalkova (INV27) Sanja Aleksić (INV28)	Santorini Hall
	14.00-15.00	**Buffet Lunch**	Zira Restaurant
	15.00-15.30	**Awards & Closing ceremony**	Mikonos Hall

Monday, September 8th, 2025.

08.00 – 09.00 **Registration** **Hotel Zira, 2nd Floor**

Mikonos Hall

09.00 – 10.00 **Opening Ceremony of the XIII Serbian Ceramic Society Conference:**

PL The impact of the availability of critical minerals on the feasibility of the energy transition

Slobodan Vukosavić

Serbian Academy of Sciences and Arts, Belgrade, Serbia

10.00 - 10.15 **Award, Photo session & Short break**

10.15 – 12.15 **Basic ceramic and Sintering**

Chairpersons: S. Filipović & J. Živojinović

10.15 – 10.45 **PL Metal bonding Ceramic Substrate by Atmosphere Plasma Spray**

Wei Pan, Guanghua Liu, Xiqiang Zhong, Yan Xing, Tianjun Li

State Key Laboratory of New Ceramics and Fine Processing, School of Materials Science and Engineering, Tsinghua University, Beijing 100084, China

10.45 – 11.15 **PL Glass and glass-ceramics with therapeutic and antimicrobial properties**

Aldo R. Boccaccini[1], Dušan Galusek[2]

[1]Institute of Biomaterials, Department of Material Science and Engineering, University of Erlangen-Nuremberg, 91058, Erlangen, Germany

[2]Centre for Functional and Surface-Functionalized Glass (FunGlass), Alexander Dubček University of Trenčín, 91150 Trenčín, Slovakia

11.15 – 11.35 **INV From densification to ablation behavior of Compositionally Complex Ultra High Temperature Ceramics**

Laura Silvestroni

CNR-ISSMC, Institute of Science, Technology and Sustainability for Ceramics, Via Granarolo 64, I-48018 Faenza, Italy

11.35 – 11.55 **INV Crystal plasticity and strengthening of ultra-high temperature carbide grains**

Tamás Csanádi[1], János Koltai[1,2], Zoltán Dankházi[1,2], Yogesh K. Ravikumar[1], Alexandra Kovalčíková[1], Michael J. Reece[3]

[1]Institute of Materials Research, Slovak Academy of Sciences, Watsonova 47, 040 01, Košice, Slovak Republic

[2]Eötvös Loránd University, Pázmány P. sétány 1/A, 1117 Budapest, Hungary

[3]School of Engineering and Material Science, Queen Mary University of London, Mile End Road, London, E1 4NS, UK

11.55 – 12.15 **INV High-entropy dual-phase ceramics: (Hf,Ti,Zr,Me$_1$,Me$_2$)B$_2$-(Hf,Ti,Zr,Me$_1$,Me$_2$)C (Me$_1$, Me$_2$ = V, Nb, Ta and Cr) systems**
Ana C. Feltrin, Simon Divilov, Gregory Hilmas, Stefano Curtarolo, William G. Fahrenholtz
Missouri University of Science and Technology, Rolla, MO, USA

12.15 – 12.30 **Coffee Break** **Hallway**

Mikonos Hall

12.30 – 14.35 **Basic ceramic and Sintering**
Chairpersons: D. Kosanović & A. Peleš Tadić

12.30 – 13.00 **PL Transparent alumina ceramics with textured structure**
Shiwei Wang
Shanghai Institute of Ceramics, Chinese Academy of Sciences, 588 Heshuo Road, Jiading district, Shanghai, 201800, China

13.00 – 13.20 **INV Advancement in UHTCMCs: processing and oxidation resistance**
Antonio Vinci, Luca Zoli, Matteo Mor, Diletta Sciti
National Research Council– Institute of Science, Technology and Sustainability for Ceramics (CNR-ISSMC) Faenza, Italy

13.20 – 13.40 **INV Fusion Welding of Ceramics in the ZrB$_2$-SiC-ZrC system**
Jeremy Watts
Materials Science and Engineering Missouri University of Science and Technology, Rolla, USA

13.40 – 14.00 **INV Influence of different types of surfactants on the physicochemical and antitumor properties of ZnO nanostructured powders prepared via microwave-assisted procedure**
Ana Stanković[1], Ivana Drvenica[2], Biljana Ristić[2], Ljiljana Veselinović[1], Smilja Marković[1]
[1]Institute of Technical Sciences of SASA, Knez MIhailova 35/IV, Belgrade, Serbia,
[2]University of Belgrade, Institute for Medical Research, Doktora Subotića 4, Belgrade, Serbia

14.00 – 14.20 **INV Interdiffusion in the ZrB$_2$ – HfB$_2$ system**
Yue Zhou, William G. Fahrenholtz, Gregory E. Hilmas
Department of Materials Science and Engineering, Missouri University of Science and Technology, Rolla, MO 65409, USA

14.20 – 14.35 **ORL Simultaneous Combustion Synthesis of Nano SiC and Pink Low-Oxygen Si$_3$N$_4$ via Coupled Strong/Weak-Exothermic Reaction Systems**
Lujia Han, Huakang Zhang, Jieyan Zhao, Jiangtao Li

Technical Institute of Physics and Chemistry, Chinese Academy of Sciences, Beijing 100190, China, University of Chinese Academy of Sciences, Beijing 100049, China

14.35 - 15.30 **Buffet Lunch** **Restaurant Zira**

Mikonos Hall

15.30 – 17.30 **Renewable Energy and Composites**
Chairpersons: M. Marčeta Kaninski & D. Milovanović

15.30- 16.00 **PL The Role of Ceramic Materials in Enhancing the Activity and Durability of Electrocatalysts for Proton and Anion Exchange Membrane Fuel Cells**
Jasna Janković, Andres Godoy, Mariah Batool, Sara Pedram, Yinyu Wang
Center for Clean Energy Engineering Department of Materials Science and Engineering University of Connecticut 44 Weaver Rd. Unit 5233, Storrs, CT 06269, USA

16.00 - 16.30 **PL Wear performance of silicon nitride in non-conventional lubrication during rolling contact**
Zulfiqar A. Khan
NanoCorr, Energy & Modelling (NCEM) Research Group Department of Design and Engineering Bournemouth University, UK

16.30 – 16.50 **INV DFT calculations of adsorption processes in design of catalytic materials for AOP degradation of organic pollutants**
Dragana Vasić Anićijević, Marija Kovačević, Marija Ječmenica Dučić, Tanja Brdarić, Danka Aćimović, Sanja Živković, Miloš Momčilović
Department of Physical Chemistry, Vinča Institute of Nuclear Sciences-National Institute of the Republic of Serbia, University of Belgrade, Mike Alasa 12-14, Vinča - Belgrade, Serbia.

16.50 – 17.10 **INV Production of durable mullite-based ceramics obtained from waste clay-diatomite**
Aleksandra Šaponjić
Vinča Institute of Nuclear Sciences, National Institute of the Republic of Serbia, University of Belgrade, Mike Petrovića Alasa 12-14, 11000 Belgrade

17.10 – 17.30 **INV Electrochemical analysis of NiFeMo on the cathode catalysts for the alkaline water electrolysis**
Sladjana Maslovara[1], Milica Marceta[1], Vladimir Nikolic[1], Zeljka Nikolic[1], Dragana Vasic Anicijevic[2], Jasna Jankovic[3], Ravel Larose[3]
[1]Institute of General and Physical Chemistry, Studentski trg 12/V, Belgrade, Serbia

[2]Vinca Institute of Nuclear Science, University of Belgrade, Mike Petrovica Alasa 12-14, Belgrade, Serbia
[3]University of Connecticut, Department of Material Science and Engineering, USA

17.30 – 18.30	**Poster Session I & Exhibition**	**Mikonos Hall**
19.00 – 23.30	**Conference dinner**	**Rodos Hall, Hotel Zira**

Tuesday, September 9th, 2025.

08.00 – 09.00	**Registration & Poster installation**	**Hotel Zira, 2nd Floor**
	Mikonos Hall	
09.00 – 11.20	**Nano, Opto and Bio-ceramics** **Chairpersons: L. Mančić & I. Dinić**	
09.00 – 09.30	**PL Nano vs. ceramic sorbents of heavy metal ions in polluted waters** Anita Grozdanov, Katerina Burevska Atkovska, Perica Paunovic Faculty of Technology and Metallurgy at the University Ss Cyril and Methodius in Skopje, Rugjer Boskovic 16, 1000 Skopje, North Macedonia	
09.30 – 10.00	**PL From Material Design to Device Fabrication: High-Efficiency Thermoelectrics Based on Mg_3Sb_2** Lei Miao, Ji-Sheng Liang, Qi Zhou, Zhengniu Pan, Zhongwei Zhang Guangxi Novel Battery Materials Research Center of Engineering Technology, State Key Laboratory of Featured Metal Materials and Life-cycle Safety for Composite Structures, School of Physical Science and Technology, Guangxi University, Nanning 530004, China	
10.00 – 10.30	**PL YAG Based Phosphor Ceramics for High-power LEDs** Youfu Zhou[1,2], Junrong Ling[1, 2], Maochun Hong[1, 2] [1]Fujian Science & Technology Innovation Laboratory for Optoelectronic Information of China, Fuzhou, 350108, China [2]Fujian Institute of Research on the Structure of Matter, Chinese Academy of Sciences, Fuzhou 350002, China	
10.30 – 11.00	**PL Silicon Carbide Nanoparticle Formation via Detonation: Influence of Additive Chemistry and Shock Dynamics** Catherine E. Johnson Department of Mining and Explosives Engineering, Missouri University of Science and Technology, Rolla, MO 65401, USA	
11.00 – 11.20	**INV ZnO as Photoelectrocatalyst for H_2 Production and Electrochemical Sensor for Water Pollutants Detection: The Influence of Oxygen Vacancies in ZnO Crystal Structure on its Functional Properties** Smilja Marković[1], Ana Stanković[1], Katarina Aleksić[1], Anđela Mitrović Rajić[1], Ivana Stojković Simatović[2] [1]Institute of Technical Sciences of SASA, Knez Mihailova 35/IV, Belgrade, Serbia [2]University of Belgrade – Faculty of Physical Chemistry, St. Trg 12-16, Belgrade, Serbia	
11.20 – 11.45	**Coffee Break**	**Hallway**

Mikonos Hall

11.45 – 14.05 **Nano, Opto and Bio-ceramics**
Chairpersons: S. Marković & M. Vuković

11.45 – 12.15 **PL Mechanistic Insights in Delamination, Kinking and Chemical Etching of MAX Phases**
Miladin Radović
Department of Material Science and Engineering, Texas A&M University, College Station, TX 77843, USA

12.15 – 12.45 **PL Lightweight and high-strength textured fibrous Si_3N_4 3D scaffold seeded with β-Si N particles prepared via freeze casting**
Jianfeng Yang, Qiang Zhi, Bo Wang
State Key Laboratory for Mechanical Behavior of Materials, Xi'an Jiaotong University, Xi'an, China

12.45 – 13.15 **PL Design and application of nanomaterials in Perovskite Solar Cells**
Hong Lin
State Key Laboratory of New Ceramic Materials, School of Materials Science and Engineering, Tsinghua University, Beijing 100084, China

13.15 – 13.45 **PL Layered ternary MAX phases and their MX particulate derivative reinforced metal matrix composite**
Zhenying Huang, Wenqiang Hu, Xue Li, Weici Zhuang
Institute of Materials Science and Engineering, School of Mechanical and Electronic Control Engineering, Beijing Jiaotong University, Beijing , China

13.15 – 13.45 **INV High-Entropy Garnets with Lanthanum: Structural Tuning and Improved Photoluminescence**
Katarina Drdlikova[1], Robert Klement[2], Tereza Havlikova[1], Monika Michalkova[3], Karel Maca[1, 4], Dusan Galusek[2, c], Daniel Drdlik[1, 4]
[1]CEITEC BUT, Brno University of Technology, Purkynova 123, 61200 Brno, Czech Republic
[2]FunGlass, Alexander Dubcek University of Trencin, Studentska 2, Trencin 911 50, Slovak Republic
[3]Vitrum Laugaricio-Joint Glass Center of the IIC SAS, TnUD and FCHTP STU, Studentska 2, Trencin, Slovak Republic
[4]Faculty of Mechanical Engineering, Brno University of Technology, Technicka 2, 61669 Brno, Czech Republic

14.05 – 15.00 **Buffet Lunch** **Restaurant Zira**

Mikonos Hall

15.00 – 17.10	**Glass and Electro/Amorphous and Magnetic** **Chairpersons: N. Mitrović & V. Paunović**
15.00 – 15.30	**PL Development of environmentally friendly lead-free piezoelectric ceramics based on $(K,Na)NbO_3$** Jing-Feng Li State Key Laboratory of New Ceramic Materials, School of Materials Science and Engineering, Tsinghua University, Beijing, China
15.30 – 16.00	**PL Potassium sodium niobate based Lead Free Piezoelectric Ceramics: From Fundamental Researches to Applications** Jie Xing, Ting Zheng, Xiang Lv, Liaming Jiang, Jiagang Wu, Jianguo Zhu College of Materials Science and Engineering, Sichuan University, Chengdu 610064, China
16.00 – 16.30	**PL Impurities in Grain-Boundaries Impacting the Mechanical and Dielectric loss of Mn doped 67PMN-33PT Piezoceramics** Ziqiong Ling[1] Yizhou Dong[1], Liaoying Zheng[1] Chul-Hong Park[3], Abdelhadi Kassiba[2], Guorong Li[1] [1]Shanghai Institute of Ceramics, Chinese Academy of Sciences, China [2]Institute of Molecules and Materials, UMR6283-CNRS, Le Mans University, Le Mans 72000, France [3]Department of Physics Education, Pusan National University, Gumjung, Pusan 46241, South Korea
16.30 – 16.50	**INV Modeling of piezoelectric ceramic rings for power ultrasound applications** Igor D. Jovanović, Vesna V. Paunović, Dragan D. Mančić Faculty of Electronic Engineering, University of Niš, Aleksandra Medvedeva 4, 18000 Niš, Serbia
16.50 – 17.10	**INV Understanding Dechlorination Efficacy and Properties of Phosphate Glasses for Molten Salt Waste Immobilization** Charmayne Lonergan Missouri University of Science and Technology, Rolla, MO, USA
17.15 – 18.15	**Poster Session II** — **Mikonos Hall**
18.45 – 20.00	**Nikola Tesla Museum** — **Krunska 51**

Wednesday, September 10th, 2025.

08.00 – 09.00 **Registration** **Hallway**

Mikonos Hall

09.00 – 11.10 **Electrocemistry and Catalysis**
Chairpersons: M. Pagnacco & M. Vujković

09.00 – 09.30 **PL Solid oxide fuel cells and water electrolysers**
Branimir N. Grgur, Aleksandra S. Popović
University of Belgrade Faculty of Technology and Metallurgy, Karnegijeva 4, 11020 Belgrade, Serbia

09.30 – 10.00 **PL Toward a Realistic Description of Single-Atom Catalysts: Insights from Electrochemical Stability Diagrams**
Igor A. Pašti[1,2], Ana S. Dobrota[1], Natalia V. Skorodumova[3]
[1]University of Belgrade − Faculty of Physical Chemistry, Studentski trg 12-16, 11158 Belgrade, Serbia
[2]Serbian Academy of Sciences and Arts, Knez Mihailova 35, 11000 Belgrade, Serbia
[3]Applied Physics, Division of Materials Science, Department of Engineering Sciences and Mathematics, Luleå University of Technology, Luleå, 971 87 Sweden

10.00 – 10.30 **PL Activation of carbonyl moiety by metal- and acid-free catalysts – Esterification of Aryl/Alkyl acids by *N*-halamines**
Bojan Božić[1], Klara Čebular[2], Jelena Lađarević[3], Miloš Petković[4], Dušan Mijin[3], Stojan Stavber[2]
[1]University of Belgrade, Institute of Physiology and Biochemistry "Ivan Djaja", Faculty of Biology, Studentski trg 3, 11000 Belgrade, Serbia
[2]Jožef Stefan Institute, Department of Physical and Organic Chemistry, Jamova 39, 1000 Ljubljana, Slovenia
[3]University of Belgrade, Faculty of Technology and Metallurgy, Karnegijeva 4, 11000 Belgrade, Serbia
[4]University of Belgrade, Faculty of Pharmacy, Vojvode Stepe 450, 11221 Belgrade, Serbia

10.30 – 10.50 **INV Luminescent lanthanide materials and their applications in luminescent thermometry and nonlinear properties**
Dimitrije Mara[1,2], Milica Ćalić[1,2], Danka Radić[1], Marija Petrović[1], Anđelka Isaković[3], Marko Janković[4], Jovana Vunduk[1]
[1] Institute of General and Physical Chemistry, Studentski trg 12/V 11158, P. O. Box 45, Belgrade, Serbia. Email: dmara@iofh.bg.ac.rs
[2]Joint Lab "The Belt and Road" The Physical Chemistry of Materials: Biological, Energy and Environmental Applications, Institute of General

and Physical Chemistry, Belgrade Serbia and Southwest University, Chongqing, China.
[3]Institute of Medical and Clinical Biochemistry, Faculty of Medicine, University of Belgrade, dr Subotića starijeg 8, 11000, Belgrade, Serbia
[4]Institute of Microbiology and Immunology, Faculty of Medicine, University of Belgrade, dr Subotića starijeg 8, 11000, Belgrade, Serbia

10.50 – 11.10 **INV Fragmentation of CF_4^+ and CF_3^+ in the bulk (vacuo) and in the vicinity of copper cathode in gaseous detectors**
Nebojša N. Begović[1], Jelena D. Jovanović[1], Predrag Milenović[2,3]
[1]Institute for General and Physical Chemistry, Studentski Trg 12-16/V 11158 Belgrade, Serbia
[2]CERN - European Particle Physics Laboratory Experimental Physics Department CH-1211 Geneva 23, Switzerland
[3]University of Belgrade, Faculty of Physics, Studentski Trg 12-16, 11158 11158 Belgrade, R. Serbia

10.50 – 11.10 **INV Comparative structural analysis of M-doped (M = Ru, Sb, Ni, Co) -TiO_2 as support materials in Pt-based catalysts for application in fuel cells**
Boris Rajčić[1], Slađana Maslovara[1], Dubravka Milovanović[1], Milica Marčeta Kaninski[1], Vladimir Nikolić[1], Janez Kovač[2], Zoran Šaponjić[1]
[1]Institute of General and Physical Chemistry, Studentski trg 12/V, Belgrade, Serbia
[2]Jožef Stefan Institute, Jamova Cesta 39, Ljubljana, Slovenia

11.10 – 11.30 **Coffee Break** **Hallway**

11.30 – 13.25 **Electrocemistry and Catalysis/Modelling**
Chairpersons: M. Pagnacco & M. Vujkovic

11.30– 12.00 **PL Tailoring of grain boundary structure and chemistry for sintering and properties of solid oxide cell materials**
Ni Na[1,2], Shi Yinchun[2], Yan Wenyi[3], Zhao Yuye[4], Zhu Lei[1], Huang Zhen[1]
[1]School of Mechanical and Power Engineering, Shanghai Jiao Tong University, Shanghai, 200240
[2]School of Materials Science and Engineering, Shanghai Jiao Tong University, Shanghai, 200240
[3]School of Physics and Astronomy, Shanghai Jiao Tong University, Shanghai, 200240
[4]Electron Microscopy Center, Public Innovation Service Platform, East China Normal University, Shanghai, 200241

12.00 – 12.20 **INV Advances in solid-state kinetics models: Case studies of pyrophyllite dehydroxylation and doped MgH_2 dehydration**
Branislav Stanković[1], Sara Mijaković[1], Zorana Sekulić[2], Jasmina Grbović Novaković[1],Bojana Paskaš Mamula[1],Ana Vujačić Nikezić[1],Vanja Asanović[3]

[1]Vinča Institute of Nuclear Sciences-National Institute of the Republic of Serbia, University of Belgrade, Centre of Excellence for Hydrogen and Renewable Energy, Belgrade, Serbia, POB 522, 11000 Belgrade, Serbia
[2]Directorate for Energy and Energy Efficiency, Ministry of Capital Investments, The Government of Montenegro, Rimski trg 46, 81000 Podgorica, Montenegro
[3]Faculty of Metallurgy and Technology, University of Montenegro, Cetinjski Put 2, 81000 Podgorica, Montenegro

12.20 – 12.40 **INV Zn^{2+} ion Storage in $ZnMn_2O_4$ and $ZnCr_{0.15}Mn_{1.85}O_4$ Cathode Materials in an Aqueous Solution of $ZnCl_2$**
Jelena Senćanski[1], Nenad Nikolić[2], Maja Pagnacco[3], Jelena Maksimović[4], Ivana Stojković Simatović[4]
[1]University of Belgrade, Institute of General and Physical Chemistry, Studentski trg 12-15, 11000 Belgrade, Republic of Serbia
[2]University of Belgrade, Institute for Multidisciplinary Research, Kneza Višeslava 1, 11030 Belgrade, Republic of Serbia
[3] University of Belgrade, Institute of Chemistry, Technology and Metallurgy, Njegoševa 12, 11000 Belgrade, Serbia
[4]University of Belgrade, Faculty of Physical Chemistry, Studentski trg 12-15, 11000 Belgrade, Republic of Serbia

12.40 – 13.00 **INV Electrochemical characteristics of LiV_2O_5 cathode material in aqueous and non-aqueous electrolyte**
Miloš Milović[1], Milica Vujković[2], Dragana Jugović[3]
[1]Department of Theoretical Physics and Condensed Matter Physics, “Vinča” Institute of Nuclear Sciences - National Institute of the Republic of Serbia, University of Belgrade, Serbia
[2]Faculty of Physical Chemistry, University of Belgrade, Belgrade, Serbia
[3]Institute of Technical Sciences of SASA, Belgrade, Serbia

13.00 – 13.15 **ORL Ciprofloxacin degradation from aqueous solutions using a green-synthetized Co-carbon-smectite nanocomposite**
Gordana Stevanović, Nataša Jović-Jovičić, Sanja Marinović, Zorica Mojović, Predrag Banković, Jovan Parlić, Marija Ajduković
University of Belgrade, Institute of Chemistry, Technology and Metallurgy, Department of Catalysis and Chemical Engineering, Njegoševa 12, 11000 Belgrade, Republic of Serbia

13.15 – 13.35 **INV Application of 2D and 3D Digital Image Correlation in Biomedical Material and Structure Testing**
Nenad Mitrović
University of Belgrade, Faculty of Mechanical Engineering, Center for optical measurement, Kraljice Marije 16, Belgrade, Serbia

13.35 – 13.55 **INV Role of Atomic Oxygen in High Quality SiOx Thin Film Deposition: Exploring New Chemical Pathways for Polymerization and Surface Treatment**
Ilija Stefanović
Institute of Technical Sciences SASA, Belgrade, Serbia

14.00 – 15.00 **Buffet lunch** **Zira Restaurant**

15.00 – 15.30 **Awards & Closing Ceremony** **Mikonos Hall**

Santorini Hall

08.30 – 11.00 **Nano, Opto and Bio-ceramics**
Chairpersons: L. Mančić & S. Marković

08.30 – 09.00 **PL Fabrication, microstructure properties of TAG magneto-optical ceramics for high power Faraday isolators**
Jiang Li
Transparent Ceramics Research Center, Shanghai Institute of Ceramics, Chinese Academy of Sciences, Shanghai 201899, China

09.00 – 09.30 **PL Recent advancement of nano-grained transparent ceramics via full crystallization from glass**
Jianqiang Li
School of Materials Science and Engineering, University of Science and Technology Beijing, Beijing 100083, PR China

09.30 – 09.50 **INV Laser-induced graphene on biocompatible synthetic polymer substrates for electrodes and physiological parameter monitoring**
Marko Spasenović, Teodora Vićentić, Anđela Gavran, Vanja Vojnović, Katarina Tošić, Milena Rašljić-Rafajilović, Stefan Ilić, Ivan Pešić, Marija V. Pergal
Center for Microelectronic Technologies, Institute of Chemistry, Technology and Metallurgy – National Institute of the Republic of Serbia, Belgrade, Serbia

09.50 – 10.10 **INV Inorganic Materials Applications in Biotechnology: Past, Present, and Future**
Steva M. Lević
University of Belgrade-Faculty of Agriculture, Nemanjina 6, 11080, Belgrade-Zemun, 11080, Serbia

10.10 – 10.30 **INV Fabricating Luminescent Ceramics Derived from Mesoporous Powders by Spark Plasma Sintering**
Beiying Zhou[2,3], Wan Jiang[1,2,3]
[1]State Key Laboratory of Advanced Fiber Materials, College of Materials Science and Engineering, Donghua University, Shanghai 201620, P. R. China

[2]Institute of Functional Materials, Donghua University, Shanghai 201620, P. R. China
[3]Engineering Research Center of Advanced Glasses Manufacturing Technology, Ministry of Education, Donghua University, Shanghai 201620, P. R. China

10.30 – 10.45 **ORL Superparamagnetic iron oxide nanoparticle clusters with porous silica shell as a highly biocompatible theranostic platform**
Jelena Lazovic[1], Ana Mrakovic[2], Marko Djosic[2], Slavko Kralj[3], Marin Tadic[2]
[1]Max Planck Institute for Intelligent Systems, Stuttgart 70569, Germany
[2]Condensed Matter Physics Laboratory, Vinca Institute of Nuclear Sciences – National Institute of the Republic of Serbia, University of Belgrade, POB 522, 11001 Belgrade, Serbia
[3]Jozef Stefan Institute, Jamova 39, Ljubljana, 1000, Slovenia

10.45 – 11.00 **ORL Magneto-optical ceramics based on rare earth oxides for near- and medium infrared wavelength range**
Maxim Ivanov
Center of Excellence for Photoconversion, Vinča Institute of Nuclear Sciences — National Institute of the Republic of Serbia, University of Belgrade, PO Box 522, 11001 Belgrade, Serbia

11.00 – 11.30 **Coffee Break** **Hallway**

11.30 – 13.30 **Refractory, Clay and Cements/Modelling**
Chairpersons: A. Terzić & M. Vasić

11.30 – 12.00 **PL Capsules for Self-Healing Cracks in Concrete Based on Agro-Waste: Production and Effectiveness Testing**
Ivanka Netinger Grubeša, Dalibor Kramarić, Anđelko Crnoja, Aleksej Aniskin
Department of Construction, University North, 104. Brigade 3, 42000 Varaždin, Croatia

12.00 – 12.30 **PL Development of a new type of MgO-C gas supply element for bottom blowing of metallurgical furnace**
Kaiqi Liu
State Key Laboratory of Mesoscience and Engineering, Institute of Process Engineering, Chinese Academy of Sciences, Beijing, China,100190

12.30 – 12.50 **INV Some aspects of the comparative analysis of Environmental Product Declarations (EPDs) for clay construction products**
Milica Vidak Vasić, Tea Spasojević-Šantić, Zagorka Radojević
Institute for Testing of Materials IMS, Bulevar vojvode Mišića 43, 11000 Belgrade, Serbia

12.50 – 13.10 **INV Using silver coated graphite particles for electromagnetic interferenceshielding and composite production**
Stevan Stupar
University of criminal investigation and police studies, Faculty of Forensic Sciences and Engineering, Cara Dušana 196, 11080, Belgrade, Serbia

13.10 – 13.30 **INV Cold sintering of a YAG composition glass**
Monika Michálková[1], Andrea Cibrínová [1,2], Marzieh Ghadamyari[2], Jana Valúchová[1], Hamid Hassani[1], Ali Talimian[2], Dušan Galusek[1,2]
[1]Vitrum Laugaricio – Joint Glass Centre of the IIC SAS, TnUAD, FChPT STU and RONA, a.s., Študentská 2, SK-911 50, Trenčín, Slovakia
[2]FunGlass – Centre for Functional and Surface Functionalized Glass, TnUAD, Trenčín, Slovakia

13.30 – 13.50 **INV Potential of nanotechnology and photoacoustic measurements for characterizing amorphous silicon in advanced photovoltaic systems**
Sanja Aleksić[1], Dragana Markušev[2], Neda Branković[1], Aleksandar Pantić[1], Adriana Pantić[1], Nebojša Mitrović[3]
[1]University of Niš, Faculty of Electronic Engineering, Niš, Serbia
[2]Institute of Physics Belgrade, Belgrade
[3]Joint Laboratory for Advanced Materials of SASA, Section for Amorphous Systems, Faculty of Technical Sciences Čačak, University of Kragujevac, Serbia

14.00 – 15.00 **Buffet lunch** **Zira Restaurant**

15.00 – 15.30 **Awards & Closing Ceremony** **Mikonos Hall**

Book of Abstracts

PL1

The impact of the availability of critical minerals on the feasibility of the energy transition

Slobodan Vukosavić

Serbian Academy of Sciences and Arts, Kneza Mihaila 35, 11000 Belgrade, Serbia

The energy transition aims to replace fossil fuels, preserve the environment, reduce CO_2 emissions and combat climate change. Practical steps include the use of electric vehicles, the development of energy storage, as well as a significantly higher share of energy from solar and wind power plants. The above steps require a much larger amount of critical minerals that are poorly represented in the lithosphere. Obtaining critical minerals through ore extraction and processing requires significant amounts of energy and a large consumption of fossil fuels. Profitable and engineering rational approaches to ore extraction and concentrate processing create unacceptable harm to people and nature. Part of the necessary raw materials can be obtained through recycling. However, recycling critical minerals is in most cases associated with serious logistical, energy and environmental difficulties. The preliminary analysis presented here draws on engineering experience and knowledge of the critical minerals required to produce electric cars, solar power plants, wind farms and energy storage. Based on the energy transition plan until 2050 and a review of the necessary equipment, components and systems that would need to be produced by then, an estimate of the critical minerals required for such an undertaking has been made. The results show that the required quantities exceed global reserves and, in some cases, even resources. Growing problems in the procurement of critical minerals further complicate the implementation of the green agenda. In addition to the dominance of the People's Republic of China in extraction and processing, there is also growing public resistance in third world countries to cheap and environmentally harmful mining. The resulting resistance, unrest and even armed conflicts threaten the stability and reliability of supply lines. The described situation is one of the factors that make decarbonization more difficult and threaten the achievement of the set goals. According to available data, the annual growth in energy consumption from fossil fuels exceeds the growth in energy from renewable sources by many times, while the measured increase in the average global temperature calls into question the overall effects of decarbonization. Among the reasons leading to unfavorable outcomes is the established practice of managing technological development in accordance with the profitable interests of big capital. Such interests, as a rule, consider short-term time intervals and do not take into account the long-term effects of changes in the energy sector. Reliance on financial aspects is often accompanied by ignoring the laws of physics and resource constraints, as indicated by the subject analysis. The main goal of the analysis is to use scientifically based considerations on key issues in order to formulate unquestionable conclusions and consider solutions.

PL2

Metal bonding Ceramic Substrate by Atmosphere Plasma Spray

Wei Pan, Guanghua Liu, Xiqiang Zhong, Yan Xing, Tianjun Li

State Key Laboratory of New Ceramics and Fine Processing, School of Materials Science and
Engineering, Tsinghua University, Beijing 100084, China

Ceramic materials, with their resistance to high temperatures, corrosion, and wear, along with their low thermal expansion and electrical insulation properties, emerge as ideal candidates for packaging in demanding environments like aerospace, high gas seal applications, and high temperature sensing. However, the inherent differences in the physical and chemical properties of ceramics and metals, particularly in terms of strength, toughness, and thermal expansion, present significant challenges in creating effective bonds between these materials. This is a critical hurdle in the packaging process that needs to be overcome. Addressing the complex, time-consuming, and costly nature of traditional ceramic-to-metal bonding processes, this report introduces a groundbreaking approach using atmospheric plasma spraying technology. This technique allows for the direct application of metal coatings onto ceramic surfaces, producing a metal bonding layer that is both highly conductive and strongly adherent. This method represents a swift, economical, and high-quality solution to fabricating metal circuits on ceramic substrates, paving the way for advancements in the manufacture of devices requiring high integration and reliability under extreme conditions. In present report, the Cu, Ti and Ni coating on alumina, silicon nitride and aluminum nitride substrates have been demonstrated. The thermal, mechanical and electrical performances and mechanism of boding are introduced.

PL3

Glass and glass-ceramics with therapeutic and antimicrobial properties

Aldo R. Boccaccini[1], Dušan Galusek[2]

[1]Institute of Biomaterials, Department of Material Science and Engineering, University of Erlangen-Nuremberg, 91058, Erlangen, Germany
[2]Centre for Functional and Surface-Functionalized Glass (FunGlass), Alexander Dubček University of Trenčín, 91150 Trenčín, Slovakia

The continually increasing number of strains of antibiotic-resistant pathogenic microorganisms (e.g., MRSA – Methicillin-resistant Staphylococcus aureus) poses an increasing threat to our society. This problem is further aggravated by factors such as horizontal gene transfer between different bacterial strains, allowing bacteria to quickly acquire antibiotic resistance. Pharmaceutical companies are reluctant to invest in the development of new antibiotics due to high cost and a fast loss of the effectiveness of new antibiotics. Design of new strategies to combat pathogenic microorganisms is thus inevitable. An interesting alternative is represented by the development of glasses and glass ceramic materials that can exhibit antibacterial and therapeutic activity employing various mechanisms ranging from the release of inorganic ions with known therapeutic effect, such as Ag^+, Zn^{2+}, Ga^{3+}, Ce^{3+}, to controlled delivery and release of drugs directly in a diseased organ. This contribution provides an overview of joint research activities of the Centre for functional and surface functionalized glass, Alexander Dubček University of Trenčín, and the Institute of Biomaterials, University of Erlangen-Nuremberg, focusing on the development and testing of bioactive glasses, glass-ceramics, and biocomposites with a biopolymeric matrix doped with bioactive glasses containing ions with known therapeutic and antibacterial effects. Their antibacterial and antimicrobial activity against selected Gram-positive (*S. Aureus*) and Gram-negative (*E. Coli*) bacteria and microscopic fungi is documented and discussed.

Acknowledgement: The financial support of this work by the grant SAS-MOST-JRP-2022-04 is gratefully acknowledged.

PL4

Transparent alumina ceramics with textured structure

Shiwei Wang

Shanghai Institute of Ceramics, Chinese Academy of Sciences, 588 Heshuo Road,
Jiading district, Shanghai, 201800, China

Alumina crystal structure belongs to hexagonal system, birefringence of light occurs in alumina ceramics and leads to its low in-line transmittance in visible regime (~15%, 1 mm thickness). This limits its application in ceramic laser, transparent windows and armor. Our team focused on the preparation of textured structure to effectively eliminate birefringence. Firstly, strong magnetic field assisted slip casting was employed to make wet bodies. After drying and sintering, XRD patterns showed diffraction intensity of (006) plane of the top surfaces of samples enhanced, intensities of other planes with relatively larger interplanar angles to c-plane decrease and these peaks gradually disappear when increasing magnetic field strength, sintering temperature and holding time. It was found that grain orientation was strongly correlated with grain growth, not bulk densification. Size of oriented grains were larger than that of random grains when samples were prepared with the same powders and sintering condition. Finally, transparent alumina ceramics with highly oriented grains was fabricated by strong magnetic field (12T) assisted slip casting and sintering at 1850°C for 5h in vacuum using 450nm(D50) alumina powder. Its in-line transmittance reached as high as 72% at wavelength of 600nm and 71% at wavelength of 300nm. Anisotropic grain growth was observed. Grains were oriented along c-axis with an orientation degree f(006) of 97%. Similarly as in the first case, textured structure was successfully obtained by template grain growth. Alumina platelet was horizontally arranged in alumina particles by shear force of slurry flow. Taking the sample with 5 wt% platelet as an example, when it was sintered in vacuum at 1840°C for 6 hours and then hot isostatic pressing sintered at 1850°C@200 MPa, the in-line transmittance reached 78.4%@600 nm which was the highest value reported in the literatures so far. However, microstructure observation revealed that there were residual pores in the sintered bodies. This is why transmittance of the transparent alumina with textured structure was not as high as that of sapphire. Further job must be done to improve transmittance by optimizing the whole processing parameters.

PL5

The Role of Ceramic Materials in Enhancing the Activity and Durability of Electrocatalysts for Proton and Anion Exchange Membrane Fuel Cells

Jasna Janković, Andres Godoy, Mariah Batool, Sara Pedram, Yinyu Wang

Center for Clean Energy Engineering
Department of Materials Science and Engineering
University of Connecticut
44 Weaver Rd. Unit 5233, Storrs, CT 06269, USA

The transition to clean energy demands the development of durable and efficient electrochemical technologies, such as proton and anion exchange membrane fuel cells (PEMFCs and AEMFCs). A key bottleneck in these systems remains the degradation of carbon-supported platinum (Pt) and palladium (Pd) catalysts under realistic operating conditions. In this talk, we explore the emerging role of ceramic materials in enhancing both the catalytic activity and long-term durability of fuel cell electrocatalysts. The talk will first present a novel approach for stabilizing Pt/C catalysts used in PEMFCs by selectively depositing a thin (~2 nm), conformal layer of titanium nitride (TiN) onto the carbon support using hollow-cathode plasma-assisted atomic layer deposition (HCPA-ALD). This conductive ceramic coating, applied with nanometer precision, anchors Pt nanoparticles, mitigates carbon corrosion, and maintains active sites accessible for electrochemical reactions. Advanced electron microscopy and electrochemical testing confirm improved structural integrity and oxygen reduction performance. Next, we examine a CeOx–Pd/C electrocatalyst designed for AEMFCs, where cerium oxide acts synergistically with Pd to promote hydroxide spillover and enhance hydrogen oxidation reaction (HOR) kinetics. An interesting aspect of using microscopy, namely Scanning Transmission Electron Microscopy with Energy Dispersive Spectroscopy (STEM-EDS) with novel automatic way of quantifying coverage of the catalyst by CeOx, will be presented and correlated with the performance. Moreover, Identical Location Transmission Electron Microscopy (IL-TEM) reveals that CeOx not only improves catalytic activity but also significantly suppresses Pd degradation after stress testing. Together, these two case studies highlight the transformative potential of integrating engineered ceramic components into catalyst architectures, offering a promising pathway toward more resilient and efficient fuel cell technologies.

PL6

Wear performance of silicon nitride in non-conventional lubrication during rolling contact

Zulfiqar A. Khan

NanoCorr, Energy & Modelling (NCEM) Research Group
Department of Design and Engineering
Bournemouth University, UK

This study presents experimental techniques and numerical methods to assess rolling contact performance of hybrid rolling ceramic elements in nonconventional high pressure lubrication. Test configuration in terms of test bench, applied and contact pressure and rolling speed are presented. Several failure mechanisms are studied including crack initiation and propagation in extreme pressures and temperatures. The study includes experimental measurement of deep zone manufacturing induced residual stresses. Both tensile and compressive residual stresses are mapped to several failure mechanisms. Contact mechanics analysis is provided. Wear-corrosion synergistic numerical analysis and models are presented which are applicable to ceramics and composite materials in static and dynamic applications.

PL7

Nano vs. ceramic sorbents of heavy metal ions in polluted waters

Anita Grozdanov, Katerina Burevska Atkovska, Perica Paunovic

Faculty of Technology and Metallurgy at the University Ss Cyril and Methodius in Skopje,
Rugjer Boskovic 16, 1000 Skopje, North Macedonia

The global industry development has led to enormous amounts of environmental pollution. Heavy metals belong to group one of highly dangerous environmental contaminants. Once introduced into the environment, heavy metal ions are not biodegraded. Since they are toxic as well as persistent in the environment and can enter the food chain through the water channels, the water pollution by heavy metals causes many disease problems such as renal kidney disease, nervous system damages, cancer and mental retardation. Because of that, remediation of the heavy metals from the contaminated water and wastewater is very important. Some of the most widely used methods for heavy metal removal are adsorption, ion exchange, solvent extraction, electrolysis, chemical precipitation, membrane processes. The traditional materials and treatment technologies, such as activated carbon, oxidation, activated sludge, nanofiltration (NF), and reverse osmosis (RO) membranes are not effective to treat complex and complicated polluted waters. Among all of them, adsorption is the most utilized technique in wastewater purification. There are a wide list of materials that can be used as an adsorbent for heavy metals elimination from wastewaters. Various materials, such as clay minerals, zeolites, activated carbon, and metal oxides, are used as conventional adsorbents for the removal of heavy metals from wastewater. In recent years, the development of nanoscience and nanotechnology has shown remarkable potential for the remediation of environmental problems. Compared with traditional materials, nanostructured adsorbents, such as graphene and carbon nanotubes, have exhibited much higher efficiency and faster rates in water treatment.

PL8

From Material Design to Device Fabrication: High-Efficiency Thermoelectrics Based on Mg_3Sb_2

Lei Miao, Ji-Sheng Liang, Qi Zhou, Zhengniu Pan, Zhongwei Zhang

Guangxi Novel Battery Materials Research Center of Engineering Technology, State Key Laboratory of Featured Metal Materials and Life-cycle Safety for Composite Structures, School of Physical Science and Technology, Guangxi University, Nanning 530004, China

Mg_3Sb_2-based Zintl compounds offer great potential for mid- to high-temperature thermoelectric applications due to their non-toxicity, low cost, and favorable electronic properties. In our work, we systematically developed a series of high-performance p-type and n-type Mg_3Sb_2-based materials through targeted doping and structural design strategies, with a strong emphasis on synthesis control and device-level integration. For p-type materials, we employed co-doping of Na at the cation site and Bi at the anion site to simultaneously modulate the band structure and enhance phonon scattering. This strategy enabled a competitive *ZT* of 0.73 at 773 K, supported by a high power factor and reduced lattice thermal conductivity via Bi nanoprecipitates. A double-leg thermoelectric device assembled using this material achieved a conversion efficiency of 4.1% under a 390 K temperature difference. To address the mobility limitations in n-type $Mg_3(Sb,Bi)_2$, we introduced Be as a cationic dopant to weaken bond polarity and improve electronic transport. This approach led to a significant mobility increase (from ~62 to ~138 $cm^2\ V^{-1}\ s^{-1}$), a peak *ZT* of 1.54 at 673 K, and a high average *ZT* of 1.17. Further, we developed a dual-modulation doping strategy by integrating Zr-doped and intrinsic $Mg_3(Sb,Bi)_2$ phases to form electronic high-speed channels. This composite achieved a record-high average ZT of 1.7 and enabled a single-leg device with 13.6% conversion efficiency at a 467 K temperature difference. Our work demonstrates that precise compositional tuning, defect engineering, and phase boundary design can be effectively leveraged to boost both material- and device-level thermoelectric performance. These advances provide a robust foundation for the development of scalable and efficient thermoelectric systems based on Mg_3Sb_2 derivatives.

PL9

YAG Based Phosphor Ceramics for High-power LEDs

Youfu Zhou[1, 2], Junrong Ling[1, 2], Maochun Hong[1, 2]

[1]Fujian Science & Technology Innovation Laboratory for Optoelectronic Information of China,
Fuzhou, 350108, China
[2]Fujian Institute of Research on the Structure of Matter, Chinese Academy of Sciences,
Fuzhou 350002, China

As phosphor converter of high-power LEDs (hp-LEDs), YAG based phosphor ceramics have attracted more and more attention in comparison with typical resin-mixed phosphors due to their higher thermal conductivity and better physicochemical stability. However, YAG:Ce phosphor ceramics suffers from low color rendering index (CRI), which is ascribed to the yellow-emitting of YAG:Ce and deficiency of red and green emission. In this work, by the introduction of red-emitting ions or the regulation of crystal field environment, a series of YAG:Ce based transparent ceramics were prepared via a solid-state reaction-vacuum sintering method. The effects of Mn^{2+}-Si^{4+} doping and Gd^{3+} crystal field regulator upon the structure, transmittance and luminescence properties were investigated systematically. The Mn^{2+}-Si^{4+} doping can effectively modulate the PL spectra by compensating broad red component to yield high color rendering index (CRI) warm white light. The Gd^{3+} regulator also led to a obvious blue-shift of the PL spectrum. After tailored YAG based ceramic packaged with blue LED chips in COB model, CRI as high as 85 was achieved. Green compensated ceramic (YLuAG:Ce) were also prepared based on crystal engineering. The effects of Lu^{3+} doping were investigated in detail via XRD, SEM, and PL spectra. Average grain size was observed decreasing after the doping of Lu^{3+}, which can enhance the emission due to more grain boundaries and further more photoluminescence probability. YLuAG:Ce ceramic exhibits higher thermal stability that emission intensity reduces only about 8.9 % at 250 ℃ than YAG:Ce one (11.1%). The luminous efficiency (LE) of related packaged LED is more than 180 lm/W at 800W input. The above results show that YAG based phosphor ceramics can be developed as potential candidates for the converters of hp-LEDs.

PL10

Silicon Carbide Nanoparticle Formation via Detonation: Influence of Additive Chemistry and Shock Dynamics

Catherine E. Johnson

Department of Mining and Explosives Engineering, Missouri University of Science and Technology, Rolla, MO 65401, USA

This work presents a high-level overview of recent investigations into the detonation synthesis of silicon carbide (SiC) nanomaterials using conventional high explosives. Our studies demonstrate that elemental silicon can react with carbon-rich detonation products from negatively oxygen balanced RDX/TNT mixtures to form nanocrystalline β-SiC. In one series of experiments, controlled detonations in an argon environment with 3.2 wt% silicon produced ~3.1 wt% β-SiC in the condensed products. Additional work highlighted the importance of additive distribution and shock interactions, showing that phase formation is sensitive to the spatial arrangement and morphology of inert materials like silica within the explosive charge. Detonation performance, including detonation velocity and C–J pressure, was influenced by both the RDX:TNT ratio and silicon concentration, affecting the extent of carbon liberation, oxidation, and residual silicon. Simulations and experiments consistently indicated that the post-shock environment, with pressures exceeding 20 GPa and temperatures over 3000 K, is thermodynamically favorable for SiC formation. Together, these results show that the energetic environment of detonation can be engineered to drive ceramic phase formation, offering a rapid, scalable route for synthesizing high-performance nanomaterials.

PL11

Mechanistic Insights in Delamination, Kinking and Chemical Etching of MAX Phases

Miladin Radović

Department of Material Science and Engineering, Texas A&M University,
College Station, TX 77843, USA

MAX phases have challenged a typical description of ceramics due to unique set of properties. This class of 350+ members share a common chemical formula of $M_{n+1}AX_n$, (where n = 1, 2 or 3, M is and early transition metal, A is mostly group 13-16 elements, X is either C or N and n=1-5) and naonolayered crystal structure in which strongly bonded $M_{n+1}X_n$ layers are interleaved by weakly bonded A layers. In addition, chemical etching of A element from MAX phases yields a novel class of 2D ceramics (MXenes) with chemical formula of $M_{n+1}X_nT_z$ (where T stands for -F, -OH, -O, -Cl, etc. terminations). The first part of this this lecture will provide mechanistic insights in deformation by shear, delamination along basal planes and kink formation, that are all responsible for the complex, and unique mechanical response of MAX phase and their exceptional damage tolerance. Our recent results on studying anisotropic deformation and failure mechanisms in MAX single crystals, micropillars and cantilevers will be discussed in more detail. The second part of this lecture will focus on understanding the etching MAX phases to MXenes and our core-shell etching mechanism characterized by simultaneous etching of A layers and over-etching of MXenes.

PL12

Lightweight and high-strength textured fibrous Si_3N_4 3D scaffold seeded with β-Si N particles prepared via freeze casting

Jianfeng Yang, Qiang Zhi, Bo Wang

State Key Laboratory for Mechanical Behavior of Materials, Xi'an Jiaotong University,
Xi'an, China

Highly porous Si_3N_4 ceramics with unidirectionally aligned pore channels are gaining significant attention across various fields due to their outstanding functional capabilities. Herein, we design and fabricate a novel β-Si_3N_4 scaffold composed of directionally aligned lamellar walls with a textured microstructure by directionally freeze casting of α-Si_3N_4 suspensions with fine elongated β-Si_3N_4 seeds addition, followed by liquid phase sintering. During the sintering, the scaffold exhibited anisotropic shrinkage, and fibrous β-Si_3N_4 grains were synthesized through epitaxial growth on the seeds preferentially oriented or the nuclei originated from α-Si_3N_4 powders, resulting in the grains aligned parallel to lamellar walls and bridged the walls. Seed additions of 7 to 15 wt% were beneficial for the optimized distribution of the two types of β-Si_3N_4 grains, which contributed to the excellent resistance to bucking-induced fracture for the walls. Compared with other unidirectional porous Si_3N_4 prepared by freeze-casting in the literature, the Si N scaffold exhibited outstanding compressive strength, ranging from 2.8 to 22.0 MPa, as the porosity decreased from 94.4 % to 88.0 % and the density increased from 175 to 365 mg/cm^3.

PL13

Design and application of nanomaterials in Perovskite Solar Cells

Hong Lin

State Key Laboratory of New Ceramic Materials, School of Materials Science and Engineering,
Tsinghua University, Beijing 100084, China

Perovskite solar cell is a rising star in energy fields. However, its stability issue inhibits its further commercialization. Nanomaterials have been widely applied in photodevices attributed to their intriguing properties, such as quantum confinement effect and surface effect. In our works, we designed and utilized the surface of nanomaterials to improve the performance of $FAPbI_3$-based solar cells. At first, we synthesized (100) preferred cubic PbS nanosheets and prepared $FAPbI_3$-PbS nanosheet hybrid films. $FAPbI_3$ is observed to grow on PbS nanosheet epitaxially. $FAPbI_3$ films containing PbS nanosheets present excellent stability results from the chemical bonding and compression strain at $FAPbI_3$-PbS heterointerfaces. Further, to alleviate the carrier capturing from PbS nanosheets with narrow bandgap, CdS-modified PbS nanosheets were prepared. The wide-bandgap CdS layer on CPS nanosheets which is distributed at the grain boundaries of perovskite films effectively blocks the carrier transportation and recombination at grain boundaries and $FAPbI_3$-CPS heterointerfaces. As a result, the power conversion efficiency and stability of $FAPbI_3$-CPS hybrid solar cells significantly improved simultaneously. Additionally, we also successfully manipulated the film crystallization and the carrier transportation at the interface between perovskite and carbon electrode via introducing PbS, SnS quantum dots, or MoS_2 nanosheets into perovskite films. Our works demonstrate the great potential of nanomaterials applied in perovskite solar cells. In addition, this presentation will provide a holistic perspective on the current state of perovskite solar cell technology, showcase our laboratory's innovative research, and underscore China's leadership in the industrialization of this promising technology.

PL14

Layered ternary MAX phases and their MX particulate derivative reinforced metal matrix composite

Zhenying Huang, Wenqiang Hu, Xue Li, Weici Zhuang

Institute of Materials Science and Engineering, School of Mechanical and Electronic Control Engineering, Beijing Jiaotong University, Beijing, China

Since the early ‘90s in last century, an interesting combination of metallic and ceramic-like properties of MAX phases have motivated the development of MAX/metal matrix composites (MMCs). The layered MAX phases enhanced MMCs exhibited not only high strength but also sufficient deformation capacity by virtue of unique deformation behaviors of MAX in terms of delamination and the formation of kinking band, which facilitate the coordination deformation between reinforcement and metal matrix. As the precursor of in situ ultrafine binary carbide/nitride particulates, MAX phases triggered its close derivatives (MX) have also provided a general strategy for the synthesis of a wide range of in-situ MMCs. For the in-situ MX particulates enhanced MMCs, the binary MX particulates are transformed topologically from hexagonal MAX accompanied by de-intercalation of A-site element and then diffusing into metal matrices. As the formation of ultrafine and stable ceramic reinforcements, the MAX triggered in situ MMCs are found to exhibit a superior combination of mechanical strengths and ductility. Based on the investigation about MAX-MMCs (Ni-, Ti- and Al- matrix composites), this paper reviews the research progress on the preparation, reactive mechanism, microstructure characterization, mechanical and tribological properties of these composite materials. In addition, the paper also demonstrates common industrial applications of MAX-MMCs and highlights the promising outlook of MAX-MMCs.

PL15

Development of environmentally friendly lead-free piezoelectric ceramics based on (K,Na)NbO_3

Jing-Feng Li

State Key Laboratory of New Ceramic Materials, School of Materials Science and Engineering,
Tsinghua University, Beijing, China

Piezoelectric materials play an important role in various kinds of electronic devices, such as sensors, transducers and actuators. From the viewpoint of environmental protection on the earth, high-performance lead-free piezoelectric ceramics are one of urgent demands. (K,Na)NbO_3 (KNN) has been revealed as one of the most promising lead-free piezoelectric ceramic candidates, and extensive studies have been concentrated on the KNN system in the past two decades. Its piezoelectricity has been pushed to a high level even exceeding that of Pb(Zr,Ti)O_3 (PZT) family by phase boundary and multiscale structure engineering. Nevertheless, the enhanced piezoelectricity of KNN based ceramics lacks a temperature stability as compared with PZT. This talk will review the progress to develop high-performance KNN-based ceramics with high piezoelectricity and enhanced temperature stability by phase boundary and multiscale microstructure engineering. Then, I will present the most recent works about the texturing-enhanced ultrahigh piezoelectricity and simultaneous enhancement of piezoelectricity and mechanical quality factor. Finally, I will introduce some examples of application research and share my views about the further development of lead-free piezoelectric ceramics.

PL16

Potassium sodium niobate based Lead Free Piezoelectric Ceramics: From Fundamental Researches to Applications

Jie Xing, Ting Zheng, Xiang Lv, Liaming Jiang, Jiagang Wu, Jianguo Zhu

College of Materials Science and Engineering, Sichuan University, Chengdu 610064, China

For meeting the requirements of environmental protection and sustainable development of human society, the lead-free piezoelectric ceramics have attracted great attention all over the world in recent years. Potassium sodium niobate $(K,Na)NbO_3$/(KNN) based lead-free ceramics not only have satisfactory piezoelectric properties, but also have good environmental compatibility. The compelling physical properties of lead-free piezoelectric ceramics were highlighted and their state-of-the-art progresses are summarized. The unique advances in KNN-based lead-free piezoelectric ceramics, along with the main physical mechanisms of high piezoelectricity, including phase boundaries, domain configurations, and grain size effects, are also summarized. In particular, the applications of KNN-based lead-free piezoelectric ceramics are introduced and evaluated. Finally, challenge and perspective are featured on the basis of their current developments.

PL17

Impurities in Grain-Boundaries Impacting the Mechanical and Dielectric loss of Mn doped 67PMN-33PT Piezoceramics

Ziqiong Ling[1], Yizhou Dong[1], Liaoying Zheng[1] Chul-Hong Park[3],
Abdelhadi Kassiba[2], Guorong Li[1]

[1]Shanghai Institute of Ceramics, Chinese Academy of Sciences, China
[2]Institute of Molecules and Materials, UMR6283-CNRS, Le Mans University,
Le Mans 72000, France
[3]Department of Physics Education, Pusan National University, Gumjung, Pusan 46241,
South Korea

We conducted a study on Mn doping in $67Pb(Mg_{1/3}Nb_{2/3})O_3$-$33PbTiO_3$（67PMN-33PT), which is a ferroelectric material exhibiting a morphotropic phase boundary (MPB). The samples were doped with MnO_2 at mass ratios ranging from 0.5 to 5.0 wt.% and subsequently sintered at temperatures ranging from 1200 to 1260 °C. Experimental analysis of electrical properties was performed within the temperature range of -80 to·200 °C. Electron paramagnetic resonance (EPR) testing was conducted on these samples to investigate Mn solubility in PMN-PT ceramics and its existence in different valence states. The results indicate that at a doping ratio of 0.5 wt.% and sintering temperature of 1220 to 1240 °C, Mn ions achieved a homogeneous dispersion within the crystal lattice, leading to the enhanced electromechanical Q_m factor (510) and the reduced dielectric loss $tan\delta$ to minimum (0,30%) comparison to the no doping Mn, however, as the Mn ions dopant content increase higher than 1.0wt.% and sintering temperatures 1200-1260 °C, the unexpected results have been observed that both Q_m and $tan\delta$ are enhanced to about 1200, 0.87 up to 1.5wt.% MnO_2, and then, Qm decrease to 510, but $tan\delta$ increase 3.78% for 5wt.% MnO_2， the machinal of Qm and dielectric loss can understand by the (Mn-Vo) defect dipoles in lattice, domain wall and grain-bounary, together with the increasing of the MnO_2. Mn_2O_3 or their mixed phase of Mn_3O_4 in grain-boundary.

PL18

Solid oxide fuel cells and water electrolysers

Branimir N. Grgur, Aleksandra S. Popović

University of Belgrade Faculty of Technology and Metallurgy,
Karnegijeva 4, 11020 Belgrade, Serbia

In the light of climate changes, the low carbon technologies must be considered for energy production. One such examples are solid oxide based electrochemical reactors that can be used for water electrolysis and energy cogeneration in solid oxide fuel cells. Both systems are similar, but for water electrolysis, for producing green hydrogen, external power supply for example wind or solar convertors should be used, and for the electric and heat energy fuel cells could use fuel obtained by the gasification of biomass. The most common electrolyte are based on a dense ionic ceramic conductor consisting of ZrO_2 doped with Y_2O_3 (also known as YSZ, ytrium-stabilized zirconia). Zirconium dioxide is used because of its high strength, high melting temperature (approximately 2700°C) and excellent corrosion resistance, some other common choices are scandia stabilized zirconia (ScSZ), ceria based electrolytes or lanthanum gallate materials. All of these solid electrolytes can conduct O^{2-}. Due to the operation at evaluated temperature, > 650°C, the efficiency of those systems are very high, over 80%. Hence the aim of this presentation will be explanations of working principles, components of the systems, and characteristics during operation.

PL19

Toward a Realistic Description of Single-Atom Catalysts: Insights from Electrochemical Stability Diagrams

Igor A. Pašti[1,2], Ana S. Dobrota[1], Natalia V. Skorodumova[3]

[1]University of Belgrade – Faculty of Physical Chemistry, Studentski trg 12-16,
11158 Belgrade, Serbia
[2]Serbian Academy of Sciences and Arts, Knez Mihailova 35, 11000 Belgrade, Serbia
[3]Applied Physics, Division of Materials Science, Department of Engineering Sciences and
Mathematics, Luleå University of Technology, Luleå, 971 87 Sweden

Single-atom catalysts (SACs) have emerged as a versatile class of materials with significant potential across a range of catalytic applications, including electrochemical processes. Their atomically dispersed active sites offer unique opportunities for maximizing metal utilization and tuning catalytic properties. Moreover, the well-defined nature of these sites allows for detailed theoretical modeling. However, a key challenge remains: the state of the active site often changes under realistic operating conditions, such as variations in pH and electrode potential, factors frequently neglected in theoretical studies. In this contribution, we present a framework for incorporating electrochemical stability into the design and understanding of SACs by adapting the concept of surface Pourbaix diagrams. This approach enables a more accurate prediction of the active state and guides the rational development of SACs. While applicable to a wide range of SAC-support systems – including metal oxides, carbons, and ceramic matrices – we illustrate the method using representative examples based on 2D materials. Integrating electrochemical insight into catalyst design represents a valuable step toward developing efficient and robust SACs for diverse technological applications.

PL20

Activation of carbonyl moiety by metal- and acid-free catalysts – Esterification of Aryl/Alkyl acids by *N*-halamines

Bojan Božić[1], Klara Čebular[2], Jelena Lađarević[3], Miloš Petković[4],
Dušan Mijin[3], Stojan Stavber[2]

[1]University of Belgrade, Institute of Physiology and Biochemistry “Ivan Djaja”, Faculty of Biology, Studentski trg 3, 11000 Belgrade, Serbia
[2]Jožef Stefan Institute, Department of Physical and Organic Chemistry, Jamova 39, 1000 Ljubljana, Slovenia
[3]University of Belgrade, Faculty of Technology and Metallurgy, Karnegijeva 4, 11000 Belgrade, Serbia
[4]University of Belgrade, Faculty of Pharmacy, Vojvode Stepe 450, 11221 Belgrade, Serbia

In recent decades, growing environmental awareness has spurred the search for eco-friendly technologies, driving the development of greener methodologies in organic synthesis. *N*-halamines, traditionally known as affordable and easily handled halogenation agents, have recently emerged as promising acid- and metal-free catalysts. Their ability to activate carbonyl groups facilitates nucleophilic attack, enabling key transformations such as esterification, which are central to industrial-scale condensation reactions. The carbonyl moiety, due to its oxygen lone pairs, acts as a Lewis base and is typically activated by Lewis acids. However, halogen bonding – noncovalent interactions involving halogen atoms offers an alternative activation pathway. This underexplored mechanism may explain the catalytic properties of *N*-halamines under various conditions, including conventional heating and microwave irradiation. Investigating *N*-halamines from this novel perspective could significantly advance sustainable organic synthesis. An optimal reaction pathway should ideally include: (1) a low-cost, metal-free, water- and air-stable catalyst, (2) mild or solvent-free conditions, (3) no need for continuous water removal, and (4) no requirement for stoichiometric or excessive use of activators or reagents.

PL21

Tailoring of grain boundary structure and chemistry for sintering and properties of solid oxide cell materials

Ni Na[1,2], Shi Yinchun[2], Yan Wenyi[3], Zhao Yuye[4], Zhu Lei[1], Huang Zhen[1]

[1]School of Mechanical and Power Engineering, Shanghai Jiao Tong University,
Shanghai, 200240
[2]School of Materials Science and Engineering, Shanghai Jiao Tong University, Shanghai, 200240
[3]School of Physics and Astronomy, Shanghai Jiao Tong University, Shanghai, 200240
[4]Electron Microscopy Center, Public Innovation Service Platform, East China Normal University,
Shanghai, 200241

As a high temperature electrochemical device based on ceramic components, the sintering behavior of solid oxide cell materials has an important influence on the material conductivity, electrode microstructure and the final electrochemical performance of the cell.

This report investigates the performance optimization of typical gadolinium-doped cerium oxide (GDC) electrolytes and strontium manganate lanthanum (LSM) air electrode materials. By analyzing the effects and mechanisms of grain boundary structures and chemical composition on sintering microstructures, we propose a sintering strategy for solid oxide cell performance enhancement. Our findings demonstrate that developing novel low-temperature sintering methods significantly suppresses gadolinium segregation at GDC grain boundaries, reduces oxygen vacancy depletion layer width, and substantially improves material's grain boundary ionic conductivity (Figure 1a). Additionally, through high-entropy design of the A-site in LSM, we can regulate the relative content of oxygen ions and diffusion-rate limiting ions in grain boundary core and adjacent space charge regions. This approach facilitates ion vacancy diffusion along grain boundaries while inhibiting cross-grain boundary migration (Figure 1b), enabling nanostructured electrode morphology that enhances reactive surface area and battery performance.

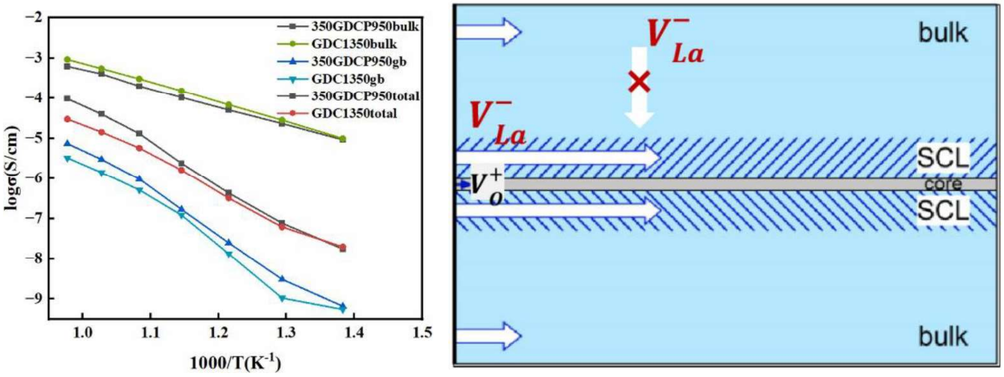

Figure 1 (a) Conductivity control of GDC based on grain boundary element segregation control; (b) SLM sintering behavior control based on A component

References：

[1] Y. Shi, H. Zhang, G. Ren et al., Acta Materialia, 2024, 271: 119906.
[2] W. Yan, N. Ni, Y. Zhao et al., Journal of the European Ceramic Society, 2025, 45:117442
[3] Y. Zhao, J. Tang, H.L. Xu et al., Journal of the American Ceramic Society, 2023, 107: 1459-1467

P22

Fabrication, microstructure properties of TAG magneto-optical ceramics for high power Faraday isolators

Jiang Li

Transparent Ceramics Research Center, Shanghai Institute of Ceramics,
Chinese Academy of Sciences, Shanghai 201899, China

The Faraday isolator is an important component of laser systems and it is mainly used to isolate the reverse light and prevent unwanted feedback between different parts of the laser systems. Faraday isolators have great significance for laser amplification and the stability of laser systems. Nowadays, high power is an important developing trend of laser systems, and the demand for magneto-optical isolators is also increasing with the increase of the laser power. Currently, the most widely used magneto-optical material in visible to near infrared wavelength band is $Tb_3Ga_5O_{12}$ (TGG) single crystals, which has good comprehensive performance and has been occupied the major market. However, it is reported that the performance of TGG crystals at high power is not sufficient, and TGG cannot meet the demand for compact Faraday isolators. Hence, researchers are looking for new magneto-optical materials with higher Verdet constant and better thermal-optical performance. The Verdet constant of $Tb_3Al_5O_{12}$ (TAG) magneto-optical ceramics is higher than that of commercial TGG single crystals, which is beneficial for the miniaturization of magneto-optical devices and systems, and has application prospects in high-power Faraday optical isolators. In this work, the microstructure, composition control and properties of TAG ceramics were mainly investigated.

P23

Recent advancement of nano-grained transparent ceramics via full crystallization from glass

Jianqiang Li

School of Materials Science and Engineering, University of Science and Technology Beijing,
Beijing 100083, PR China

Transparent ceramics have been recognized over time as a promising alternative to single-crystal and glass materials, with suitability for various optical and laser applications. shown promise for a range of other applications, including waveguide lasers, high-power light-emitting devices (LEDs and LDs), scintillators, magneto-optical materials. Diverse sintering synthetic approaches have been employed for elaborating fully dense transparent ceramics by eliminating scatter sources in polycrystalline bulk (porosity, grain boundary, etc). However, all these processes require high quality raw power (high purity, no aggregation and nanoscale), complex high pressure and high temperature sintering conditions. In recent years, full crystallization from glass has been regarded as a promising alternative strategy to achieve fully dense polycrystalline materials (i.e., ceramics showing complete absence of porosity). This process, starting from a bulk glass precursor elaborated by fast and cost-efficient glass-forming process, can lead to large scale and shapeable transparent ceramics with high doping concentrations. A variety of transparent ceramics with micrometer sized grains have been successfully prepared by low-temperature crystallization. But there have been only very few reports of nanoscale grained transparent ceramics owing to the difficulty in hindering rapid growth of crystalline nucleation during crystallization. Theoretically, the influence of grain boundary-induced scattering can be minimized, and transparency correspondingly maximized, by producing ceramics with nanoscale grain sizes down to at least 5–10 times smaller than the wavelength of incident light. Therefore, in this work, various nanograined transparent ceramics were successfully elaborated through full crystallization from glass precursors, including $Y_3Al_5O1_5$ garnet, $Lu_3Al_5O_{12}$ garnet and $GdAlO_3$ perovskite based biphasic garnet ceramics, and complex high-entropy multiphase ceramics. Nanoscale grains with non-reported fine size were realized due to the interface locking effect between heterogeneous phases. The fully crystalized nanoceramics demonstrate high optical transparency, excellent luminescent performance after doping rare earth elements, outstanding mechanical and thermal stability. These nanoceramics are believed to be promising candidates for wide optical applications such as phosphor converters, scintillators gem stones and lenses. Our work also unlocks the hidden opportunities of designing and producing phase-complex nanoceramics in high-dimensional compositional space beyond the traditional phase-pure solubility constrain.

PL24

Capsules for Self-Healing Cracks in Concrete Based on Agro-Waste: Production and Effectiveness Testing

Ivanka Netinger Grubeša, Dalibor Kramarić, Anđelko Crnoja, Aleksej Aniskin

Department of Construction, University North, 104. Brigade 3, 42000 Varaždin, Croatia

Cracks in concrete can arise from various causes, but regardless of their origin, they negatively impact the durability of concrete structures and significantly increase maintenance costs. The ability of concrete to heal its cracks is a well-documented phenomenon, particularly in the context of autogenous (or natural) self-healing. In this process, unhydrated cement particles react with incoming water forming products that fill the cracks. While autogenous healing effectively seals small cracks, it is limited in addressing wider ones. To overcome this limitation, artificial or autonomous self-healing methods have been developed. These techniques are capable of repairing larger cracks and include the use of crystalline hydrophilic additives, bacteria-based methods, and microencapsulation strategies. In bacterial self-healing, microorganisms can either be directly mixed into the concrete or delivered via carriers embedded in the fresh mix. This presentation introduces the findings of the Agro-KapS project – Agro Capsules for Improving the Properties of Reinforced Concrete Structures – which explored the use of bacteria-based self-healing with carriers made from agro-waste materials. Specifically, the study utilized grape seeds and cherry pits as carriers for the bacteria, demonstrating their potential to facilitate crack healing. Importantly, this approach is broadly applicable and can be adapted to utilize a wide variety of agro-waste types available globally.

PL25

Development of a new type of MgO-C gas supply element for bottom blowing of metallurgical furnace

Kaiqi Liu

State Key Laboratory of Mesoscience and Engineering, Institute of Process Engineering,
Chinese Academy of Sciences, Beijing, China,100190

The development of slag splashing furnace protection smelting technology has made it difficult for the service life of traditional MgO-C refractory quality bottom-blown gas supply elements for steelmaking furnaces to keep pace with the lining life. The service performance of gas supply element materials is not only affected by service conditions, but mainly influenced by the material composition and microstructure. Firstly, the k-ε model in ANSYS FLUENT was used for numerical simulation to study the temperature field changes of the refractory material matrix when the gas supply element was blowing and stirring the gas at the bottom of the steelmaking furnace. The phase reconstruction, microstructure evolution and physicochemical properties of the gas supply element materials during the bottom-blowing high-temperature nitrogen gas process in the steelmaking furnace were further studied by means of XRD, SEM and EDS. It was found that nitrogen was involved in the phase reactions and microstructure reorganization in the material matrix, thereby affecting its service performance. The magnesia-alumina spinel formed by the *in-situ* reaction of non-oxides such as SiC and Al_4SiC_4 when exposed to air after steel tapping together construct the MgO-$MgAl_2O_4$-Mg_2SiO_4 protective layer, which inhibits or delays the further reaction of non-oxides inside the refractory material, thereby improving the performance of the component. This research provides an important basis for the development of new gas supply elements that are synchronized with the furnace age.

INV1

From densification to ablation behavior of Compositionally Complex Ultra High Temperature Ceramics

Laura Silvestroni

CNR-ISSMC, Institute of Science, Technology and Sustainability for Ceramics,
Via Granarolo 64, I-48018 Faenza, Italy

Compositionally complex ceramics (CCCs) have emerged as promising candidates in the quest for materials that can withstand extreme environments. Within this family, compositionally complex borides (CCBs) are typically composed of multiple metallic elements and boron, resulting in a compound with a complex structure that can offer enhanced performance over traditional single metal borides. The exceptional hardness, high melting points, and resistance to oxidation of CCBs stem from their intricate crystal structures and the synergistic effects of their multi-element compositions. Here, we explore the microstructure evolution of ZrB_2-based compositionally complex ceramics upon sintering state and after oxidation. Multi-phase ceramics based on ZrB_2 are obtained by powder metallurgy and hot pressing resulting a multi-scale microstructure comprising a boride matrix displaying the core–shell feature, where nanoinclusions precipitate from the super-saturated solid solution. Preferential dissolution of specific metals is discussed in relation to size factor and thermodynamic considerations. Microstructure details are then correlated to the ablation behavior in an arc-jet test set-up that reached Mach number in the 3-5 range.

INV2

Crystal plasticity and strengthening of ultra-high temperature carbide grains

Tamás Csanádi[1], János Koltai[1,2], Zoltán Dankházi[1,2], Yogesh K. Ravikumar[1],
Alexandra Kovalčíková[1], Michael J. Reece[3]

[1]Institute of Materials Research, Slovak Academy of Sciences, Watsonova 47, 040 01, Košice, Slovak Republic
[2]Eötvös Loránd University, Pázmány P. sétány 1/A, 1117 Budapest, Hungary
[3]School of Engineering and Material Science, Queen Mary University of London, Mile End Road, London, E1 4NS, UK

The enhancement of strength and plasticity has been investigated in ultra-high temperature carbide grains, including (Hf-Ta-Zr-Nb)C high-entropy carbide and monocarbides such as TaC and HfC, using various experimental and computational methods. Nanoindentation and micropillar compression were performed to determine strength/hardness and slip activation in grains of different orientations. Critical resolved shear stress (crss) values corresponding to the {110}<1-10> and {111}<1-10> slip systems were calculated by first-principles density functional theory. Micropillar compression, combined with other techniques (SEM, EBSD, TEM), revealed that the crss is the lowest on the {110} glide plane with significantly enhanced value (~2.8 GPa) for (Hf-Ta-Zr-Nb)C compared to the component carbides (1.4-1.8 GPa). Still, there is a possibility to activate the {111} in specific cases. Simulated crss values correlate with experiments and make it possible to describe the experimental orientation-dependence hardness and slip activation using finite element simulations. Thus, nanoindentation is suggested to be a quick and efficient tool to assess the grain strength and to search for the activation of {111}<1-10> systems which endow rock salt carbides with improved plasticity.

Acknowledgements: This research was supported by the Slovak Academy of Sciences via the project of IMPULZ IM-2022-67.

INV3

High-entropy dual-phase ceramics: (Hf,Ti,Zr,Me_1,Me_2)B_2-(Hf,Ti,Zr,Me_1,Me_2)C (Me_1, Me_2 = V, Nb, Ta and Cr) systems

Ana C. Feltrin, Simon Divilov, Gregory Hilmas, Stefano Curtarolo, William G. Fahrenholtz

Missouri University of Science and Technology, Rolla, MO, USA

In previous research, we demonstrated that combining Group 4 elements (Hf, Ti, Zr) with V, Nb, Ta, and Cr, successfully resulted in 4-metals high-entropy ultra-high temperature dual-phase ceramics (HEDP). These ceramics contained one boride and one carbide phase, without the formation of additional phases. Introducing a fifth element has the potential to further increase configurational entropy and tailor the material properties of these materials. By combining Group 4 elements with different pairs of V, Nb, Ta and Cr resulted in six compositions: HEDP-Cr-Nb, HEDP-Cr-Ta, HEDP-Cr-V, HEDP-Nb-Ta, HEDP-Nb-V and HEDP-Ta-V. The oxide powders of the desired metals were mixed with carbon and boron carbide and boro/carbothermal reduction reaction was performed at 1660°C. Densification was done in Spark Plasma Sintering (SPS) at temperatures of 1900°C or 1950°C. All resulting materials were dual-phase ceramics, with grain sizes between 0.7-2.5µm. Compositions with V had the highest hardness, with the higher for the HEDP-Ta-V, H_{V1}=29.1±0.8GPa, while Cr-containing ceramics exhibited lower values, down to H_{V1}=23.6±0.6GPa for HEDP-Cr-Nb. Metal segregation was highly dependent on the composition, but overall it showed that Hf and Ta mostly segregated to carbide phase, while and Cr, V and Ti preferred the boride phase. Zr and Nb were more evenly distributed between the two phases.

INV4

Advancement in UHTCMCs: processing and oxidation resistance

Antonio Vinci, Luca Zoli, Matteo Mor, Diletta Sciti

National Research Council– Institute of Science, Technology and Sustainability for Ceramics (CNR-ISSMC) Faenza, Italy

There is increasing demand for materials capable of withstanding the extreme conditions of aerospace environments, such as high temperatures, mechanical stress, thermal shocks, corrosion, and wear. Ultra-refractory ceramic matrices (carbides and borides of transition metals) reinforced with carbon fibers offer high mechanical strength, toughness, heat resistance, and oxidation durability. Several processing methods, including chemical vapor infiltration (CVI), polymer infiltration and pyrolysis (PIP), reactive melt infiltration (RMI), and sintering by hot pressing (HP) or spark plasma sintering (SPS), have been explored for these materials. This study aims to give an overview of the main processing routes to obtain these materials and a comparison of the oxidation resistance of ultra-refractory composites at 1650°C. The most promising materials were further tested in plasma wind tunnel experiments at temperatures between 2000°C and 2500°C. Results indicate that sintered ceramic matrices provide the best protection, though they require careful control of processing parameters.

INV5

Fusion Welding of Ceramics in the ZrB_2-SiC-ZrC system

Jeremy Watts

Materials Science and Engineering
Missouri University of Science and Technology, Rolla, USA

Historically, ceramic joining has consisted of metallic brazes and glassy phases. These techniques can be effective, however, the task becomes more difficult when the use case involves an extreme environment, whether due to temperature, corrosion, radiation, or something else. A brazed, or glassy phase, joint will necessarily have different properties than the parent material. If it were possible to use fusion welding to join ceramic components, then the joint would have nominally the same properties as the parent material, leading to a robust joint. Research at Missouri S&T has focused on Tungsten Inert Gas (TIG) and Plasma Arc Welding (PAW) of boride-based systems, specifically ZrB_2, due to its attractive mechanical properties, high electrical and thermal conductivities, and its potential uses in various extreme environments. Welded compositions in the ZrB_2-SiC-ZrC ternary system have been investigated both to elucidate their welded properties and to better understand the ternary phase diagram. Eutectic compositions were found to be different than those reported in literature. Microstructural analysis was performed on various compositions to better understand the evolution of the fusion zone microstructure. Mechanical test specimens of select compositions were prepared and tested to compare the fusion zone strength to that of the parent material.

INV6

Influence of different types of surfactants on the physicochemical and antitumor properties of ZnO nanostructured powders prepared via microwave-assisted procedure

Ana Stanković[1], Ivana Drvenica[2], Biljana Ristić[2], Ljiljana Veselinović[1], Smilja Marković[1]

[1]Institute of Technical Sciences of SASA, Knez MIhailova 35/IV, Belgrade, Serbia,
[2]University of Belgrade, Institute for Medical Research, Doktora Subotića 4, Belgrade, Serbia

This work investigates the synthesis of zinc oxide (ZnO) nanoparticles through a microwave-assisted procedure and the physicochemical characterization of the obtained materials. The application of microwave synthesis provides a fast, efficient and energy-friendly method for producing ZnO nanoparticles of specific morphologies. This method allows control of particle size and shape, altering them optimal for various applications in research and industry. Important part of the research focuses on the use of surfactants, specifically citric acid (CA) and cetyltrimethylammonium bromide (CTAB), on the morphology and structural properties of the prepared ZnO. These surface agents act as stabilizers during synthesis procedure, enabling the preparation of nanoparticles with enhanced physicochemical properties. Experimental results show that the selection of surfactants significantly modifies the structure and surface defects in the ZnO crystal. In addition, the potential antitumor properties of ZnO nanoparticles as reagents in biomedical applications were investigated. In combination with their unique physicochemical properties, these nanostructural materials show promising results in targeting and apoptosis of tumor cells. Overall, it is concluded that the synthesis of ZnO nanoparticles via microwave processes, as well as the modification of their properties through the use of surfactants, offers a significant influence to the development of new materials for biomedical applications. Future research is essential for better understanding the mechanisms underlying the action of these nanoparticles and their practical application in clinical settings.

INV7

Interdiffusion in the ZrB_2 – HfB_2 system

Yue Zhou, William G. Fahrenholtz, Gregory E. Hilmas

Department of Materials Science and Engineering, Missouri University of Science and
Technology, Rolla, MO 65409, USA

The interdiffusion of Zr and Hf in the ZrB_2 - HfB_2 system was studied using diffusion couples. ZrB_2 and HfB_2 powders were synthesized by boro-carbothermal reduction. The materials used for synthesis were commercial ZrO_2 or HfO_2 along with B_4C and carbon black. The synthesized powders were densified by spark plasma sintering. After fabrication of high purity bulk ceramics, specimens were sectioned and polished. Polished surfaces of ZrB_2 and HfB_2 ceramics were used to make diffusion couples that were annealed at temperatures ranging from 2000°C to 2200°C for different times. The morphologies and elemental concentrations near the ZrB_2 - HfB_2 interfaces were characterized using scanning electron microscopy, transmission electron microscopy, and energy dispersive spectroscopy. Interdiffusion flux profiles were constructed based on the EDS line scans, and the interdiffusion coefficients were calculated. Finally, Arrhenius plots were constructed for each element and the corresponding activation energies were calculated.

INV8

DFT calculations of adsorption processes in design of catalytic materials for AOP degradation of organic pollutants

Dragana Vasić Anićijević, Marija Kovačević, Marija Ječmenica Dučić, Tanja Brdarić, Danka Aćimović, Sanja Živković, Miloš Momčilović

Department of Physical Chemistry, Vinča Institute of Nuclear Sciences-National Institute of the Republic of Serbia, University of Belgrade, Mike Alasa 12-14, Vinča - Belgrade, Serbia

Advanced oxidation processes (AOPs) utilize specially designed catalytic materials to enhance the efficiency of organic pollutant degradation. Density functional theory (DFT) - based calculations are an irreplaceable tool in characterization of catalytic materials, including structural and energetic parameters. However, the complexity of the AOP systems often requires a compromise between method applicability and precision. DFT calculations of adsorption energetics are robust, reliable, appropriate for further derivation of descriptors, and computationally cheap. In this contribution, we will focus on the DFT calculations of adsorption energies and their role in deeper understanding of AOP principles. Particularly, we will discuss the existing DFT-based models that implement adsorption properties of involved species to predict degradation efficiency. The first specific case covers the correlation of adsorption energetics of oxygen evolution (OER) intermediates on composite electrode surfaces, and electrochemical AOP (EAOP) efficiency. Another specific case refers to the comprehensive DFT-characterization of series of d-metals deposited on TiO_2 surface, prepared as the photocatalysts for degradation of ciprofloxacin. DFT insights into the adsorption energetics of metal atoms and OH-radical as reaction intermediate, have been correlated with structural features and photocatalytic efficiency. The models shed light on the role of adsorption in AOPs, potentially improving future catalyst design.

Acknowledgement: This work was supported by the Ministry of Science, Technological Development, and Innovation of the Republic of Serbia [grant number 451-03-136/2025-03/200017].

INV9

Production of durable mullite-based ceramics obtained from waste clay-diatomite

Aleksandra Šaponjić

Vinča Institute of Nuclear Sciences, National Institute of the Republic of Serbia, University of Belgrade, Mike Petrovića Alasa 12-14, 11000 Belgrade, Serbia

Mullite-based ceramics have been fabricated using waste clay-diatomite from the surface coal mine Baroševac, Kolubara (Serbia). The starting diatomite powder, which is mainly composed of SiO_2 phase (70.48 wt. %) and minor Al_2O_3 phase (13.78 wt. %), was mixed with the appropriate amount of $Al(NO_3)_3\cdot 9H_2O$ to obtain the stoichiometric mullite composition ($3Al_2O_3\cdot 2SiO_2$). After preparing the precursor powder a uniaxial pressing into green compacts was followed, and the examined samples were sintered at 1300, 1400, and 1500 ºC for 1 and 4 hours. During the processing period, interlocked rod-like mullite grains appeared (aspect ratio 1:10) in the sample sintered at 1500ºC. According to the XRPD analysis, the sample at 1400°C consists of mullite, cristobalite, and corundum phase, while the sample at 1500 °C contains only mullite (99 wt. %). Both samples exhibited an exceptional compressive strength (up to 188 MPa at 1400 ºC). A slight drop in compressive strength at 1500 °C (136 MPa) may be ascribed to the change in phase composition and disappearance of the alumina (corundum) phase. Although well-developed microstructure forming interlocked typical mullite grains (apparent porosity around 37%) could cause drop of compressive strength, even though the bulk density rose to 2.58 g/cm3 (relative density around 82 %) and open porosity dropped to 3 %. The excellent mechanical stability of samples starting from mined diatomaceous earth obtained at 1400 and 1500 °C without use of any binders and additives encourages further research and guides it towards mullite-based insulating materials.

INV10

Electrochemical analysis of NiFeMo on the cathode catalysts for the alkaline water electrolysis

Sladjana Maslovara[1], Milica Marceta[1], Vladimir Nikolic[1], Zeljka Nikolic[1],
Dragana Vasic Anicijevic[2], Jasna Jankovic[3], Ravel Larose[3]

[1]Institute of General and Physical Chemistry, Studentski trg 12/V, Belgrade, Serbia
[2]Vinca Institute of Nuclear Science, University of Belgrade, Mike Petrovica Alasa 12-14, Belgrade, Serbia
[3]University of Connecticut, Department of Material Science and Engineering, USA

In the quest for sustainable energy solutions, green hydrogen production through alkaline water electrolysis is pivotal. This study focuses on enhancing hydrogen production efficiency by investigating catalysts composed of d-metals (Ni, Co, and Mo) added in situ on a nickel surface. Density Functional Theory (DFT) calculations reveal that the hydrogen adsorption energy for Ni aligns well with existing literature. Incorporating Fe atoms weakens hydrogen binding compared to pure Ni, while Mo atoms strengthen it. At lower current densities, voltage reductions range from 4% to 18% at higher densities with NiFeMo catalysts compared to non-activated systems. Electrochemical techniques, including polarization curves and impedance spectroscopy, were utilized to explore the electrocatalytic performance in hydrogen evolution reactions. Morphological analysis using SEM and EDS mapping showed a surface featuring parallel indents, holes, and small agglomerations in the catalyst layer. The Ni map follows the pattern of parallel scuffs on the surface.

INV11

ZnO as Photoelectrocatalyst for H_2 Production and Electrochemical Sensor for Water Pollutants Detection: The Influence of Oxygen Vacancies in ZnO Crystal Structure on its Functional Properties

Smilja Marković[1], Ana Stanković[1], Katarina Aleksić[1], Anđela Mitrović Rajić[1],
Ivana Stojković Simatović[2]

[1]Institute of Technical Sciences of SASA, Knez Mihailova 35/IV, Belgrade, Serbia
[2]University of Belgrade – Faculty of Physical Chemistry, St. Trg 12-16, Belgrade, Serbia

Nowadays, driven by population growth, economic development and changing consumption patterns, we are facing two major global problems, the energy crisis and clean water scarcity. Besides, the increasing demand for clean water is directly related to the growing problem of water pollution. The energy crisis can be overcome by employing Fujishima and Honda's idea about the hydrogen production by solar-driven photoelectrochemical (PEC) water splitting using semiconductor as a photoanode. This pioneering idea of producing hydrogen through PEC, developed in 1972, gained significant recognition in the 21st century as a sustainable and green energy technology. Problem with water pollution can be mitigated by the safe wastewater treatment before it's discharge into the environment, along with continuous monitoring of pollutants. Among variety of analytical methods, electrochemical sensors (ECS) are acknowledged due to superior selectivity, sensitivity and response time in detecting and monitoring environmental pollutants. The most important analytical performances of ECS can be significantly improved through modification of the bare electrode surface with semiconductor materials. Thus, two major global challenges, energy shortage and water pollution, can be overcome by developing multifunctional semiconductors effective as photoelectrocatalysts and electrochemical sensors. Zinc oxide (ZnO) is a semiconductor material which combines properties such as electrochemical activity, chemical and photochemical stability and non-toxicity, thus can be used for application in electronics, opto-electronics, as well as in electrochemical and biological sensing technologies for detection and monitoring of water pollutants. During the years we have used different approaches to develop multifunctional ZnO-based materials with improved photoelectrocatalytic and sensing properties. We have found that functional properties of ZnO can be improved by tailoring amount and type of oxygen vacancies in the crystal structure which can be achieved by employing different surfactants (PEO, CTAB, Pluronic F127, etc.) as additive during microwave processing of $Zn(OH)_2$ precipitate. To comprehend the influence of oxygen vacancies on functional (photoelectrocatalytic and sensing) properties of synthesized ZnO particles, at first, their crystal structure, morphological, textural, and optical properties have been investigated in detail. The photoelectrocatalytic activity for hydrogen evolution reactions has been tested in acidic and alkaline electrolytes using linear sweep voltammetry while the electrochemical sensing activity of glassy carbon electrode modified by synthesized ZnO particles has been tested for detection of Diclofenac in water using cyclic voltammetry. Improvement in functional properties is correlated with amount and type of oxygen vacancies.

Acknowledgement: This research was funded by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia (contract nos. 451-03-136/2025-03/200175 and 451-03-137/2025-03/200146). The authors SM, AS, KA and ISS acknowledge the financial support from the Science Fund of the Republic of Serbia, The Program PRISMA, #7377, Water pollutants detection by ZnO-modified electrochemical sensors: From computational modeling via electrochemical testing to real system application – WaPoDe.

INV12

High-Entropy Garnets with Lanthanum: Structural Tuning and Improved Photoluminescence

Katarina Drdlikova[1], Robert Klement[2], Tereza Havlikova[1], Monika Michalkova[3],
Karel Maca[1, 4], Dusan Galusek[2, 3], Daniel Drdlik[1, 4]

[1]CEITEC BUT, Brno University of Technology, Purkynova 123, 61200 Brno, Czech Republic

[2]FunGlass, Alexander Dubcek University of Trencin, Studentska 2, Trencin 911 50,
Slovak Republic
[3]Vitrum Laugaricio-Joint Glass Center of the IIC SAS, TnUD and FCHTP STU, Studentska 2,
Trencin, Slovak Republic
[4]Faculty of Mechanical Engineering, Brno University of Technology, Technicka 2, 61669 Brno,
Czech Republic

The present study aims to address the influence of high-entropy (HE) structures on their optical behaviour, with a particular focus on photoluminescence (PL) properties. A series of erbium-doped HE aluminium garnets have been synthesised and structurally characterised, and their PL performance has been compared with that of conventional garnet systems. Lanthanum, typically excluded from garnet lattices due to its substantial ionic size, was incorporated into the HE matrix to assess its suitability for PL applications, particularly given its minimal interaction with other rare earth (RE) dopants. Various La-containing compositions were prepared by combustion synthesis and analysed by X-ray diffraction (XRD) and energy-dispersive X-ray spectroscopy. While the integration of La into the HE garnets phase was successful, heat treatment above 1050 °C led to phase separation, with La segregating into perovskite and β-alumina phases, as confirmed by high-temperature XRD. The thermal stability of La-containing RE-doped garnet structures was significantly enhanced by partial replacement of aluminium with scandium or a combination of gallium and scandium. The PL intensity exhibited a notable enhancement in HE matrices compared to conventional garnet structures, underscoring their suitability for advanced optical applications.

INV13

Modeling of piezoelectric ceramic rings for power ultrasound applications

Igor D. Jovanović, Vesna V. Paunović, Dragan D. Mančić

Faculty of Electronic Engineering, University of Niš, Aleksandra Medvedeva 4,
18000 Niš, Serbia

In this paper, the modeling of piezoelectric ceramic rings, which are used in the realization of powerful ultrasonic transducers, will be presented. A special layered sandwich structure (metal-piezoceramic rings-metal) was used to generate high ultrasonic power. The mentioned structure represents an ultrasonic transducer in which the ring-shaped piezoelectric material oscillates simultaneously with other metal parts. In this structure, the operating frequency is around 20-60 kHz and depends not only on the resonant frequency of the piezoelectric rings, but also on the resonant frequencies of other passive parts. In order to model piezoelectric ceramic rings and entire ultrasonic transducers, one-dimensional and three-dimensional models were developed. The mentioned models can be presented through electro-mechanical equivalent circuits or in an analytical form. With the development of computer systems and new software tools, numerical methods are becoming more and more present in the field of the development of new ultrasonic power transducers. However, results obtained using numerical methods require a large number of calculations, making the development and optimization process of transducers inflexible. In contrast, analytical methods offer advantages reflected in greater flexibility and faster transducer optimization. Finally, verification of the obtained simulation results was conducted by comparing them with experimental measurements of the input electrical impedance of both piezoelectric ceramic rings and whole ultrasonic power transducers.

INV14

Understanding Dechlorination Efficacy and Properties of Phosphate Glasses for Molten Salt Waste Immobilization

Charmayne Lonergan

Missouri University of Science and Technology, Rolla, MO, USA

As advancements occur in next-generation nuclear technology for reliable energy, the need to dispose of resulting waste remains a key issue to explore. For chloride salt-based waste streams, phosphate glasses have been investigated and show promise for a process that includes dechlorination and immobilization into a stable, glass waste form. Utilizing spectroscopic techniques such as Mössbauer, UV/Vis, FTIR, and Raman, coupled with High-Performance Liquid Chromatography, X-ray Diffraction, and various thermal analyses; the evolution of the glass structure with chlorine removal and addition of iron oxide will be discussed. During processing, certain techniques can be used to monitor reactions in-situ which can be crucial for efficient, full-scale operations. Additionally, the impact of the phosphate source (H_3PO_4 or $NH_4H_2PO_4$) will be explored as a function of temperature and environment (air versus argon), as well as glass composition. All these factors impact how robust the final glassy materials are, as determined using chemical durability testing (via ASTM C1308). This work shows the impact of the understanding of salt-precursor reactions and material chemistry on final waste form behavior.

INV15

Luminescent lanthanide materials and their applications in luminescent thermometry and nonlinear properties

Dimitrije Mara[1,2], Milica Ćalić[1,2], Danka Radić[1], Marija Petrović[1], Anđelka Isaković[3], Marko Janković[4], Jovana Vunduk[1]

[1]Institute of General and Physical Chemistry, Studentski trg 12/V 11158, P. O. Box 45, Belgrade, Serbia.
[2]Joint Lab “The Belt and Road” The Physical Chemistry of Materials: Biological, Energy and Environmental Applications, Institute of General and Physical Chemistry, Belgrade Serbia and Southwest University, Chongqing, China.
[3]Institute of Medical and Clinical Biochemistry, Faculty of Medicine, University of Belgrade, dr Subotića starijeg 8, 11000, Belgrade, Serbia.
[4]Institute of Microbiology and Immunology, Faculty of Medicine, University of Belgrade, dr Subotića starijeg 8, 11000, Belgrade, Serbia.

Luminescent lanthanide materials have been in use from the last decade of 19th century when the Austrian scientist Carl Auer von Welsbach has patented the light mantle called Auer mantle of Auer light. From that time till know the luminescent lanthanide materials have found application in different fields of photonics from lasers, lighting, telecommunications, sensors to quantum applications. Molecular luminescent lanthanide materials give wider range of the flexibility in use from the inorganic based luminescent lanthanide materials, as there is possibility of design of specific material for the application which it will be used for. Also, it is possible to introduce it into different more complex matrixes (such as sol-gels, polymers). This presentation will discuss silica nanoparticles doped with lanthanide β-diketonate complexes for use in luminescent thermometry within the physiological temperature range and an extended temperature range from -50 °C to 45 °C, exhibiting high temperature sensitivity above 2.5 %/°C. Further research will explore metal-organic frameworks (MOFs) and their photophysical properties, which offer a wide array of potential applications including sensing, lighting, telecommunications, and nonlinear optical properties such as second harmonic generation (SHG) and multiphoton fluorescence (MPF). These properties hold significant promise for advancements in quantum technologies.

INV16

Fragmentation of $CF_4{}^+$ and $CF_3{}^+$ in the bulk (vacuo) and in the vicinity of copper cathode in gaseous detectors

Nebojša N. Begović[1], Jelena D. Jovanović[1], Predrag Milenović[2,3]

[1]Institute for General and Physical Chemistry, Studentski Trg 12-16/V 11158 Belgrade, Serbia
[2]CERN - European Particle Physics Laboratory Experimental Physics Department CH-1211 Geneva 23, Switzerland
[3]University of Belgrade, Faculty of Physics, Studentski Trg 12-16, 11158 11158 Belgrade, R. Serbia

The most frequently used gas in various gaseous detectors (GD), CMS, RPC, CSC, etc is the CF_4, which is usually mixed with Ar and CO_2. Its enable easy and fast drift of electrons in GD. An additional function of CF_4 is to clean both the cathode and the anode from unwanted deposits that degrade the performance of the detector itself during operation. Quantum-chemical calculation (QCC) is applied to get deeper insight into the reactions which occurs during the detectors work, in the bulk (vacuo) and in the vicinity of copper electrode. The Potential Energy Surface - Curve (PES) are constructed for the $CF_3{}^+$ and $CF_4{}^+$, and the values for activation energies (Ea) of corresponding reactions are calculated by QCC, DFT and appropriate basis set. The value of Ea for the first stage of $CF_3{}^+$ fragmentation in the vicinity of copper electrode is $\approx$1 eV, while in the vacuo Ea $\approx$ 6.8 eV for the same process. On the contrary, Ea for the first stage of $CF_4{}^+$ fragmentation near the copper electrode is $\approx$12 eV, and $\approx$ 0.01 eV in the vacuo. The Ea were calculated for each stage of fragmentation process near copper electrode and compared with those obtained in bulk - vacuum. Copper electrode significantly changes the course of investigated reaction in his vicinity for all of investigated species - ions.

INV17

Advances in solid-state kinetics models: Case studies of pyrophyllite dehydroxylation and doped MgH_2 dehydration

Branislav Stanković[1], Sara Mijaković[1], Zorana Sekulić[2], Jasmina Grbović Novaković[1],
Bojana Paskaš Mamula[1], Ana Vujačić Nikezić[1], Vanja Asanović[3]

[1]Vinča Institute of Nuclear Sciences-National Institute of the Republic of Serbia, University of Belgrade, Centre of Excellence for Hydrogen and Renewable Energy, Belgrade, Serbia, POB 522, 11000 Belgrade, Serbia
[2]Directorate for Energy and Energy Efficiency, Ministry of Capital Investments, The Government of Montenegro, Rimski trg 46, 81000 Podgorica, Montenegro
[3]Faculty of Metallurgy and Technology, University of Montenegro, Cetinjski Put 2, 81000 Podgorica, Montenegro

Pyrophyllite ($Al_2[Si_4O_{10}](OH)_2$) is material widely used in ceramics production, while MgH_2 is often part of glass-ceramic electrolyte composites. The aim of this study is to investigated kinetics of pyrophyllite dehydroxylation and MgH_2 dehydration, which are process important for above-mentioned applications. Pyrophyllite ore was mixed with 2–10 wt.% of $AgNO_3$ and subjected to mechanochemical activation for varying milling durations. MgH_2 was synthesized with the addition of 2–5 wt.% of W and Mo, also at different time intervals. All materials were characterized using X-ray diffraction, FTIR spectroscopy, dynamic light scattering, and scanning electron microscopy. For the pyrophyllite/$AgNO_3$ composite, thermogravimetric analysis was performed, while for the doped MgH_2, temperature-programmed desorption curves were used to investigate the reaction kinetics. Kinetic curves were modeled using several approaches. The classical kinetic model failed to describe either process accurately, suggesting that both exhibit dispersed kinetics. Mass loss during non-isothermal heating of pyrophyllite was described using a linear combination of two Weibull functions. In contrast, the dehydration of doped MgH_2 required Brouers–Sotolongo functions, which are more general representations of fractal kinetics. The kinetic parameters calculated from the modeled curves were correlated with the structural and morphological features of the materials.

INV18

Zn^{2+} ion Storage in $ZnMn_2O_4$ and $ZnCr_{0.15}Mn_{1.85}O_4$ Cathode Materials in an Aqueous Solution of $ZnCl_2$

Jelena Senćanski[1], Nenad Nikolić[2], Maja Pagnacco[3], Jelena Maksimović[4],
Ivana Stojković Simatović[4]

[1]University of Belgrade, Institute of General and Physical Chemistry,
Studentski trg 12-15, 11000 Belgrade, Republic of Serbia
[2]University of Belgrade, Institute for Multidisciplinary Research, Kneza Višeslava 1, 11030 Belgrade, Republic of Serbia
[3] University of Belgrade, Institute of Chemistry, Technology and Metallurgy,
Njegoševa 12, 11000 Belgrade, Serbia
[4]University of Belgrade, Faculty of Physical Chemistry, Studentski trg 12-15, 11000 Belgrade, Republic of Serbia

To help address the highly toxic and flammable nature of commercial Li-ion batteries, this research examines novel cathode materials operating in aqueous Zn-ion batteries. Bearing in mind that aqueous electrolytes are completely environmentally friendly as well as Zn is less toxic compared to Li, such a battery may possess the potential to replace current commercial Li-ion batteries. Two cathode materials were synthesized following glycine-nitrate-combustion procedures: $ZnMn_2O_4$ and $ZnCr_{0.15}Mn_{1.85}O_4$. The samples obtained were then subjected to XRPD, SEM and cyclic voltammetry in a saturated aqueous solution of $ZnCl_2$. The XRPD confirmed a spinel structure, while the SEM presented agglomerated nano-metric particles for both materials. The capacities obtained for $ZnMnO_4$ at the slowest rate were ~18 mAh g^{-1} and for $ZnCr_{0.15}Mn_{1.85}O_4$ ~2 mAh g^{-1}. In order to increase the capacities, 1M $Mn(NO_3)_2$ was added into the system. The capacity increased to ~100 mAh g^{-1} for 5mV s^{-1} when 6ml of the solution was added. By connecting several cells sequentially, such capacity would match that of current commercial Li-ion batteries. The results here obtained show the potential that aqueous Zn-ion batteries may replace commercial Li-ion batteries.

INV19

Electrochemical characteristics of LiV_2O_5 cathode material in aqueous and non-aqueous electrolyte

Miloš Milović[1], Milica Vujković[2], Dragana Jugović[3]

[1]Department of Theoretical Physics and Condensed Matter Physics, “Vinča” Institute of Nuclear Sciences - National Institute of the Republic of Serbia, University of Belgrade, Serbia
[2]Faculty of Physical Chemistry, University of Belgrade, Belgrade, Serbia
[3]Institute of Technical Sciences of SASA, Belgrade, Serbia

Due to the ability of vanadium to have different oxidation states, as well as the layered structure that allows intercalation of various metal ions, vanadium oxides are interesting candidates for potential application as cathodes in rechargeable batteries. Intercalation of lithium into α-V_2O_5 leads to structural rearrangement and, depending on the amount of intercalated lithium x, to successive formation of various lithiated phases: α-, ε-, δ- and γ-$Li_xV_2O_5$. For its stability in the wide range of concentration x (up to $x \approx 1.8$), γ-$Li_xV_2O_5$ holds the advantage over other lithiated derivatives of V_2O_5. Within this study, electrochemical performances of pristine γ-LiV_2O_5 and composite γ-LiV_2O_5/C have been investigated in different electrolytes. Gamma structure contains two crystallographic sites for lithium accommodation. Lithium intercalation at Li1 and Li2 occurs at 3.6V and 2.4V (vs. Li metal), respectively. Intercalation at Li1 position is reversible in both organic and aqueous electrolyte and provides stable cycling performance at the high voltage. The prepared LiV_2O_5/C composite achieves significant storage capacity enhancement (up to 112%) when compared to pristine LiV_2O_5. Sluggish intercalation at Li2 sites causes unstable performance and storage capacity fade at lower voltages; this happens as the result of inactivity of Li2 position within metastable ζ-$Li_2V_2O_5$.

INV20

Application of 2D and 3D Digital Image Correlation in Biomedical Material and Structure Testing

Nenad Mitrović

University of Belgrade, Faculty of Mechanical Engineering, Center for optical measurement,
Kraljice Marije 16, Belgrade, Serbia

Digital Image Correlation (DIC) is an advanced non-contact optical method extensively utilized for full-field strain measurement. This study presents several distinct applications of both 2D and 3D DIC techniques in the field of biomedicine. Specifically, the research highlights the efficiency of DIC methods in the precise mechanical evaluation of dental materials, providing essential insights into their deformation behavior under clinical-relevant loads. The paper evaluates their mechanical performance and identifying deformation patterns that are critical for predicting functional stability and reliability. Additionally, 3D DIC has been successfully implemented for monitoring real dental and biomedical structures (e.g. dental and hip implants), demonstrating the method’s potential in detecting early signs of material deterioration and structural failure. The results underscore the versatility and precision of 2D and 3D DIC methods, reinforcing their indispensable role in advancing material testing and facilitating the development of robust structures for various biomedical engineering applications.

INV21

Role of Atomic Oxygen in High Quality SiOx Thin Film Deposition: Exploring New Chemical Pathways for Polymerization and Surface Treatment

Ilija Stefanović

Institute of Technical Sciences SASA, Belgrade, Serbia

Plasma Enhanced Chemical Vapor Deposition (PECVD) is well proven method for depositing high quality barrier films and membranes based on SiOx. Usually, the deposition starts with volatile monomer containing Si and oxygen, either hexamethyldisiloxane (HDMSO) or tetraethyl orthosilicate (TEOS), which are the precursors for polymerization of thin film. To eliminate excessive carbon and hydrogen, atomic oxygen is used, which leads to improvement of film's morphology and structure by densifying and cross –linking the film layers. These two processes, polymerization and production of flux of oxygen atoms, are commenced in plasma or electrical gas discharge in monomer/oxygen mixture. Here we discuss whether it is possible to use the oxygen atoms in double role: (i) to control the deposited film properties and (ii) to initialize and control the polymerization process. Two monomers are tested, HDMSO and TEOS respectively, and deposited thin films are analyzed by X-ray Photoelectron Spectroscopy (XPS) and Fourier –Transformed Infra-Red (FTIR) absorption spectroscopy.

INV22

Laser-induced graphene on biocompatible synthetic polymer substrates for electrodes and physiological parameter monitoring

Marko Spasenović, Teodora Vićentić, Anđela Gavran, Vanja Vojnović, Katarina Tošić,
Milena Rašljić-Rafajilović, Stefan Ilić, Ivan Pešić, Marija V. Pergal

Center for Microelectronic Technologies, Institute of Chemistry, Technology and Metallurgy –
National Institute of the Republic of Serbia, Belgrade, Serbia

Laser-induced graphene (LIG) is a highly adaptable platform with a wide range of applications, including physiological parameter sensing, electrodes, gas sensors and biosensors. Despite its potential, research on LIG has mainly focused on rigid substrates and materials that lack good biocompatibility — an essential factor for sensors designed for direct skin contact. To overcome this challenge, we present an innovative approach: laser-induced graphene formation on biocompatible, synthetically produced, cross-linked polymers. These include sodium–alginate, poly(dimethylsiloxane)/poly(ethylene glycol) (PDMS/PEG) composites, cross-linked polyurethanes (PUs) derived from ethoxypropyl-terminated PDMS macrodiol, synthesized cross-linked polyimides (PI) and PU/PI composites. With their strong mechanical properties, non-cytotoxic chemistry and excellent biocompatibility, these materials offer promising prospects for wearable sensors. In our study, we determine the optimal chemical formulations and laser processing parameters to facilitate LIG formation on these biocompatible substrates. In addition, we demonstrate the practical functionality of LIG-based devices for heartbeat and limb movement detection and their use as electrodes in electrochemical applications. The results of our research pave the way for the development of novel, biocompatible, unobtrusive, low-cost and highly efficient LIG thin-film sensors and electrodes.

This research was supported by the Science Fund of the Republic of Serbia, #4950, Polymer/graphene heterostructures for physiological sensors – Polygraph.

INV23

Inorganic Materials Applications in Biotechnology: Past, Present, and Future

Steva M. Lević

University of Belgrade-Faculty of Agriculture, Nemanjina 6, 11080, Belgrade-Zemun,
11080, Serbia

Biotechnological processes are based on the use of various biocatalysts such as microorganisms, enzymes and plant and animal cells. Many biotechnological processes require the presence of inorganic materials as support and protection for the biocatalysts or as substrate. Traditionally, inorganic materials are used in filtration processes or as adsorbents. The removal of unwanted ions from drinking and process water and unstable molecules from food still depends on inorganic adsorbents. One of the applications of inorganic materials in biotechnology is the support of biocatalysts, i.e. immobilization. The most important biotechnological processes that rely on immobilized biocatalysts are some industrial enzyme processes and wastewater treatments. Microbial cells immobilized on inorganic solid supports have also been used for the production of various food products. For these applications, materials such as glass, ceramics and natural minerals are used in various stages of modification. Inorganic materials are also suitable for transformation into new forms under the action of biocatalysts. The most important process of this type is biomineralization. A good example of the application of biocatalysts in mineralization is the formation of bioconcrete, a new, promising material (with lower CO_2 emissions) with the potential for self-healing.

Acknowledgement: This work was supported by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia (contract 451-03-137/2025-03/200116).

INV24

Fabricating Luminescent Ceramics Derived from Mesoporous Powders by Spark Plasma Sintering

Beiying Zhou[2,3], Wan Jiang[1,2,3]

[1]State Key Laboratory of Advanced Fiber Materials, College of Materials Science and Engineering, Donghua University, Shanghai 201620, P. R. China
[2]Institute of Functional Materials, Donghua University, Shanghai 201620, P. R. China
[3]Engineering Research Center of Advanced Glasses Manufacturing Technology, Ministry of Education, Donghua University, Shanghai 201620, P. R. China

Due to the attractive properties as excellent thermal and chemical resistance, high visible light transparency, and high thermal diffusion coefficient, transparent ceramic is probably an ideal matrix of luminescent materials. By introducing different lighting dopants, the luminescent ceramics with different properties have been widely used. However, the high temperature required to prepare transparent ceramic by conventional methods could be as high as 1873 to 2573K, which is an obstacle for controllable synthesis and well protection of the embedded materials. Thus, the preparation technologies of the luminescent ceramics are facing new challenges because of these volatile and unstable lighting dopants that are easy to be decomposed. This report introduces a novel, facile route for the preparation of stable monolithic ceramic-based luminescent materials, which can be widely used to introduce temperature-sensitive functional materials into the transparent matrix, by Spark Plasma Sintering (SPS). Furthermore, the research progress and superiority of SPS technology used to develop the light-emitting ceramics containing nanocrystals, perovskite, and phosphors. Owing to the fast sintering procedure of SPS with relatively low temperature, the size, shape, surface topography, and optical properties of the dopants in luminescent ceramics are found to be similar to those of untreated counterparts, which means that the sensitive dopants can be completely protected.

INV25

Some aspects of the comparative analysis of Environmental Product Declarations (EPDs) for clay construction products

Milica Vidak Vasić[1], Tea Spasojević-Šantić[1], Zagorka Radojević[1]

[1]Institute for Testing of Materials IMS, Bulevar vojvode Mišića 43, 11000 Belgrade, Serbia

When creating an Environmental Product Declarations (EPDs), it is necessary to establish Product Category Rules (PCR). PCR is a group of rules, requirements and guidelines on the basis of which the Environmental Product Declaration (EPD) is formed. The Product Category Rules (PCR) are used to complement the General Program Instructions (GPI), e.g. in terms of calculation rules, production scenarios and content of the EPD declaration. They ensure that functionally similar products are evaluated in the same way when performing Life Cycle Assessment (LCA) and for product comparison. They represent a key part of the ISO 14025 standard as they enable transparency and comparability between EPD declarations. This study examines key findings from Environmental Product Declarations (EPDs) for clay construction products conducted using two platforms: the EPD Hub and the International EPD System. It analyzes parameters such as Global Warming Potential (GWP) from fossil sources, total GWP, freshwater consumption and energy consumption, with results standardized to a functional unit of 1 kg for the product stage, modules A1-A3. Based on the results of the analysis, as well as the rules of the ISO 14025 standard, comparability of EPDs for construction products is possible only within the same product group and within the same program operator. Also, the comparability of EPDs for clay construction products is conditioned by the choice of specialized software in which the LCA of the product is modeled, as well as the selection of specific or generated data from available databases for each stage of the product's life cycle.

Acknowledgments: This investigation is supported by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia (Contract No. 451-03-136/2025-03/200012).

INV26

Using silver coated graphite particles for electromagnetic interference shielding and composite production

Stevan Stupar

University of criminal investigation and police studies, Faculty of Forensic Sciences and Engineering, Cara Dušana 196, 11080, Belgrade, Serbia

Modern devices primarily communicate wirelessly, and as the number of such devices continues to rise in households and various industries, failures caused by electromagnetic interference are becoming increasingly common. Graphite is already an excellent electrical conductor, but when its particles are coated with silver, their electrical conductivity significantly improves. The metallization of graphite particles by the deposition of silver particles onto their surfaces was studied. By using a silver conductive dispersion obtained *via* a modified Tollens process and annealing process, elemental silver was deposited to the surfaces of the graphite particles. The characterization of the particles included in this study is the examination of electrical conductivity and the dependence of the effectiveness of electromagnetic interference shielding (EMI SE) on the amount of silver complex used. After the characterization, compact samples of composites based on epoxy resins were made for the purpose of testing products for EMI SE. The conductivity measurements result of the samples increases with the amount of the conductive complex, rising from 1.10×10^3 S/cm² for untreated graphite particles to an extraordinary 14.29×10^3 S/cm² for silver modified particles. The EMI SE intensity increases by 21% with the deposition of silver compared to the unmodified graphite.

INV27

Cold sintering of a YAG composition glass

Monika Michálková[1], Andrea Cibrínová[1,2], Marzieh Ghadamyari[2], Jana Valúchová[1],
Hamid Hassani[1], Ali Talimian[2], Dušan Galusek[1,2]

[1]Vitrum Laugaricio – Joint Glass Centre of the IIC SAS, TnUAD, FChPT STU and RONA, a.s.,
Študentská 2, SK-911 50, Trenčín, Slovakia
[2]FunGlass – Centre for Functional and Surface Functionalized Glass, TnUAD, Trenčín, Slovakia

Cold sintering (CS) is an innovative consolidation technique that involves partial dissolution of glass or ceramic particles by a solvent to create a temporary liquid phase. Ceramics or glasses can be thus sintered at temperatures as low as 400 °C under applied uniaxial pressure, offering energy benefits and preventing undesired reactions at higher temperatures. The CS was applied for amorphous powders of yttrium aluminium garnet composition, which are known for their high tendency to crystallisation. The powders were prepared by combustion synthesis, with a burnout process tailored to produce amorphous, partially crystalline, and crystalline powders, respectively. All three types of powders were densified by cold sintering at temperatures ranging from 150°C to 350°C and pressures between 250 MPa and 400 MPa, with duration times varying from 30 minutes to 2 hours. As a transition liquid, a 5-10 M NaOH water solution was used. A phenomenological model, based on Herrings-Nabarro model, was employed to analyse the densification of samples and evaluate the roles of time, temperature, pressure and concentration of the NaOH solution. The impact of each parameter on the density and microstructure of the obtained samples is critically discussed.

Acknowledgement: The authors gratefully acknowledge the financial support from the Slovak Grant Agency of the Ministry of Education, Science, Research, and Sport, VEGA 2/0077/24, APVV-23-0352, and APVV-23-042

INV28

Potential of nanotechnology and photoacoustic measurements for characterizing amorphous silicon in advanced photovoltaic systems

Sanja Aleksić[1], Dragana Markušev[2], Neda Branković[1], Aleksandar Pantić[1],
Adriana Pantić[1], Nebojša Mitrović[3]

[1]University of Niš, Faculty of Electronic Engineering, Niš, Serbia
[2]Institute of Physics Belgrade, Belgrade
[3]Joint Laboratory for Advanced Materials of SASA, Section for Amorphous Systems,
Faculty of Technical Sciences Čačak, University of Kragujevac, Serbia

Amorphous silicon (a-Si) is a significant material in the field of thin-film photovoltaic cells due to its favorable combination of cost-effectiveness, flexibility, and tunable optoelectronic properties. However, its structural disorder and high defect density limit the performance of devices in which it is used. Considering that crystalline silicon has been studied for many years within nanotechnology methods, and its mechanical and thermal characteristics have been described using photoacoustic techniques, there are initial attempts to apply these two methods also for the characterization of amorphous silicon. Advanced nanotechnological methods enable precise shaping of nanostructures that can improve light absorption and reduce recombination losses. Photoacoustic spectroscopy (PAS) is a highly sensitive experimental technique that allows non-destructive characterization of optical and thermal properties, which is crucial for understanding and optimizing a-Si layers. Experimental measurements can be supported by the application of SILVACO and MATLAB software packages, enabling modeling of heat transfer and acoustic wave propagation in the investigated layers. The expected results, with such integration of nanotechnology and photoacoustic methods, should enable a deeper understanding of the mechanisms of local energy dissipation, changes in thermal conductivity, and the role of defects in absorption properties, as well as changes in the mechanical and elastic properties of the given layers. Proposing a model that would enable the prediction of changes in the optical, mechanical, and electrical properties of amorphous silicon would be a significant step toward optimizing its performance, as well as that of other materials in next-generation photovoltaic systems and nanosensors.

Keywords: Amorphous silicon, nanotechnology, photoacoustic spectroscopy, thin-film photovoltaics, optical properties, thermal conductivity, defect characterization, heat transfer modeling, MATLAB simulations, SILVACO, nanosensors, mechanical properties.

ORL1

Simultaneous Combustion Synthesis of Nano SiC and Pink Low-Oxygen Si_3N_4 via Coupled Strong/Weak-Exothermic Reaction Systems

Lujia Han, Huakang Zhang, Jieyan Zhao, Jiangtao Li

Technical Institute of Physics and Chemistry, Chinese Academy of Sciences,
Beijing 100190, China
University of Chinese Academy of Sciences, Beijing 100049, China

Nano silicon carbide (SiC) and silicon nitride (Si_3N_4) as high-performance ceramic materials have important application value in high temperature engineering, electronic devices and energy fields. However, current methods for preparing nano-SiC and high-purity Si_3N_4 have significant limitations in terms of cost and production efficiency. In this paper, a chemical furnace assisted combustion synthesis method was proposed. The synthesis of nano-scale β-SiC and high-purity pink β-Si_3N_4 was achieved through the integration of a Si-C and Si-N_2 reaction system with in situ auto-catalytic purification. The process parameters and reaction mechanism were systematically studied, and it was demonstrated that the method offers a novel approach for the economical and large-scale preparation of high-performance ceramic materials.

ORL2

Ciprofloxacin degradation from aqueous solutions using a green-synthetized Co-carbon-smectite nanocomposite

Gordana Stevanović, Nataša Jović-Jovičić, Sanja Marinović, Zorica Mojović,
Predrag Banković, Jovan Parlić, Marija Ajduković

University of Belgrade, Institute of Chemistry, Technology and Metallurgy, Department of Catalysis and Chemical Engineering, Njegoševa 12, 11000 Belgrade, Republic of Serbia

Catalytic advanced oxidative degradation is a promising technique for the removal of organic pollutants from water. This study presents a hydrothermal synthesis approach for preparing a cobalt-containing chitosan-derived carbon-smectite catalyst. The obtained catalyst was used for activation of Oxone® (potassium peroxymonosulfate). Activated Oxone® was applied in catalytic degradation of antibiotic ciprofloxacin that was used as a model of the pharmaceutical pollutant. A green cobalt-carbon-smectite nanocomposite was synthetized by hydrothermal carbonization of intercalated mixture of Co^{2+} ions and biopolymer chitosan into smectite structure at 180 °C during 24 h. After completed carbonization process, the obtained material was separated by filtration, rinsed with distilled water and ethanol, and dried until constant mass. The resulting cobalt-carbon-smectite nanocomposite was characterized using X-ray powder diffraction, Fourier transform infrared spectroscopy, and low-temperature nitrogen adsorption-desorption isotherms to investigate phase composition, presence of surface functional groups and textural properties of synthetized composite. The catalytic activity of the nanocomposite was evaluated in the degradation of ciprofloxacin in the presence of Oxone®, a precursor of sulfate ($SO^{\cdot -}$) radicals. The degradation of ciprofloxacin was investigated with respect to initial ciprofloxacin concentrations (10 mg dm^{-3} - 80 mg dm^{-3}), and temperature (25 °C to 50 °C). The concentration of ciprofloxacin was monitored using UV-Vis spectrophotometry at wavelength of 277 nm within 240 min. The kinetic and thermodynamic parameters were calculated from the experimental results. The green-synthesized catalyst demonstrated excellent performance in the Oxone®-activated degradation of ciprofloxacin, highlighting its potential for sustainable wastewater treatment applications.

Acknowledgement: This research has been financially supported by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia (Contract No: 451-03-136/2025-03/200026).

ORL3

Superparamagnetic iron oxide nanoparticle clusters with porous silica shell as a highly biocompatible theranostic platform

Jelena Lazovic[1], Ana Mrakovic[2], Marko Djosic[2], Slavko Kralj[3], Marin Tadic[2]

[1]Max Planck Institute for Intelligent Systems, Stuttgart 70569, Germany
[2]Condensed Matter Physics Laboratory, Vinca Institute of Nuclear Sciences – National Institute of the Republic of Serbia, University of Belgrade, POB 522, 11001 Belgrade, Serbia
[3]Jozef Stefan Institute, Jamova 39, Ljubljana, 1000, Slovenia

Aim: To synthesize silica coated biocompatible iron oxide particles with high saturation magnetization intended for targeted drug delivery. High saturation magnetization should enable actuation and control of the particles using external magnetic field gradients. Such particles should have high transverse relaxivity aiming at easy tracking and visualization under magnetic resonance imaging (MRI). The porous silica shell can be utilized for drug loading.

Methods and results: Superparamagnetic iron oxide nanoparticle clusters (SPIONc) coated with porous silica (silica@SPIONc) were synthesized via wet colloidal chemical processes and sol-gel silica deposition approach. Magnetization measurements at 300 K indicated superparamagnetic behavior, with no coercivity or remanent magnetization, consistent with the Langevin function. The densely packed superparamagnetic nanocrystals (≈ 10 nm diameter) in the silica@SPIONc cores produced a significant magnetic moment ($m_{nc} \approx 1.3 \times 10^6\ \mu_B$), allowing easy movement under an external magnetic field. Transverse relaxivity, measured using 7 T Bruker MRI scanner was $r_2 \approx 345\ mM^{-1}s^{-1}$. Cytotoxicity was evaluated using murine macrophages and live dead staining kit. Almost no cytotoxicity was observed at two measured concentrations (0.02 and 0.12 mM).

Conclusions: Highly biocompatible iron oxide nanoparticles encapsulated with porous silica shell were prepared, and used as theranostic platform in combination with MRI.

ORL4

Magneto-optical ceramics based on rare earth oxides for near- and medium infrared wavelength range

Maxim Ivanov

Center of Excellence for Photoconversion, Vinča Institute of Nuclear Sciences — National Institute of the Republic of Serbia, University of Belgrade, PO Box 522, 11001 Belgrade, Serbia

Faraday isolators are important elements of laser systems and are used as "optical diodes" - to isolate laser radiation and propagate it in a given direction. Currently, the main efforts of researchers in the development of new magneto-optical materials for the isolators are aimed at finding media that are transparent in the near and mid-IR ranges, with high thermal and magneto-optical properties. The presented report shows the possibility of using ceramic technologies to obtain new magneto-optical ceramics based on Dy_2O_3, Ho_2O_3, Er_2O_3 and Gd_2O_3 sesquioxides. The developed technologies for obtaining highly dispersed powders, their compaction and sintering, as well as the results of studies of the obtained nanopowders and ceramics are discussed in detail. A series of transparent ceramics of $(Ho_{1-x}La_x)_2O_3$, $(Er_{1-x}La_x)_2O_3$, $(Dy_{0.95-y}Y_yLa_{0.05})_2O_3$ solid solutions were made using vacuum sintering. Ceramics of $(Gd_{1-z}Y_z)_2O_3$, $(Gd_{1-z}Lu_z)_2O_3$ were made by hot pressing. Optimum compositions for obtaining highly transparent ceramics were found. The highest values of the Verdet constant were obtained for ceramics based on dysprosium and holmium oxides. It is shown that, in comparison with materials based on terbium oxide, which have strong resonant absorptions at wavelengths greater than 1.4 μm, ceramics based on holmium oxide can be used as a magnetoactive medium at wavelengths of about 1.5 μm and 3 μm (for lasers based on Er^{3+} ions), and dysprosium oxide at wavelengths in the region of 2 μm (for lasers based on Tm^{3+}, Ho^{3+} ions).

P1 **Poster Session I**

Influence of mechanochemical activation on the sorption characteristics of sodium carbonate

Nataša Đorđević[1], Slavica Mihajlović[1], Vladan Kašić[1],
Srđan Matijašević[1], Milica Vlahović[2]

[1]Institute for Technology of Nuclear and Other Mineral Raw Materials,
Franchet d'Esperey Blvd. 86, Belgrade, Serbia
[2]University of Belgrade, Institute of Chemistry, Technology and Metallurgy,
Karnegijeva 4, Belgrade, Serbia

Carbon dioxide is a secondary product of many industrial systems, which significantly affects the increase in its content in the air. This carbon dioxide directly affects environmental pollution. Absorption of the obtained CO_2 in industrial plants is very important in the process of environmental protection. It has been observed that sodium carbonate has the ability to absorb carbon dioxide, and that mechanochemical activation significantly enhances this property. In this work, sodium carbonate is a mechanical activation and its sorption properties are monitored by X-ray diffraction and BET methods.

P2

Enhancements of electrochemical capacitance through silane-functionalization of NbC_2 MXene

Vanja Vojnović, Ivan Pešić, Anđela Gavran, Katarina Tošić,
Marko Spasenović, Marija V. Pergal

Institute of Chemistry, Technology and Metallurgy, Center for Microelectronic Technologies,
University of Belgrade, Belgrade, Republic of Serbia

MXenes emerged as a promising class of 2D materials for energy storage applications, owing to their tunable surface terminations and high electrical conductivity. While titanium carbide-based MXenes (e.g., $Ti_3C_2T_x$) have been extensively studied, other transition metal carbides remain relatively unexplored, particularly with respect to surface functionalization strategies. To address this gap, we synthesized Nb_2C MXene and functionalized its surface with three different silane coupling agents: PEG-silane, acrylate-silane, and amino-silane, to investigate the impact of surface chemistry and modification on electrochemical performance. Scanning electron microscopy coupled with energy-dispersive X-ray spectroscopy (SEM-EDS) confirmed the successful etching of aluminum from the $NbAlC_2$ MAX phase, and the subsequent surface functionalization of Nb-MXene. Brunauer–Emmett–Teller (BET) analysis provided insights into the specific surface area and pore structure, allowing correlation with the electrochemical behavior of the silane-functionalized MXene. Static water contact angle (WCA) measurements were employed to assess the effect of silane modification on surface wettability and MXene stability in aqueous electrolytes. Electrochemical characterization was performed in a Swagelok cell configuration using cyclic voltammetry (CV), galvanostatic charge/discharge (GCD), and electrochemical impedance spectroscopy (EIS), with the aim of evaluating the capacitance, rate capability, and cycling stability

of the Nb-based electrodes. This study highlights a pathway for tailoring surface chemistry and interlayer spacing in MXenes, offering new strategies to enhance their performance in advanced energy storage devices.

This research was supported by the University of Belgrade - Institute of Chemistry, Technology and Metallurgy through the "Seed Research Grant" for young scientists ("*Surface Functionalized Niobium-Based MXene Electrodes for Enhanced Capacitance and Energy Storage Performance (SurfMEX)"),* financed by Serbia Accelerating Innovation and Entrepreneurship Project (SAIGE).

P3

Synthesis and characterization of MXene freestanding electrode for energy storage application

Ivan Pešić, Vanja Vojnović, Andjela Gavran, Katarina Tošić,
Marko Spasenović, Marija V. Pergal

Center for Microelectronic Technologies, Institute of Chemistry, Technology and Metallurgy,
National Institute of the Republic of Serbia, University of Belgrade, Njegoševa 12, 11000
Belgrade, Serbia

Two-dimensional MXenes have emerged as outstanding electrode materials for energy storage and sensing applications, owing to their metal-like conductivity, hydrophilic surfaces, and high specific surface area. Among them, Nb_2C MXene stands out due to its higher theoretical capacity, improved ion transport kinetics, near-zero bandgap, and enhanced structural stability, making it a promising candidate for the development of advanced electrode architectures. In this work, we investigated the effects of surface modification of freestanding Nb_2C MXene films using three different silane coupling agents: 2-methoxy[polyethyleneoxy)6-9propyl]trimethoxysilane (PEG-silane), 3-methacryloxypropyltrimethoxysilane (acrylate-silane), and (3-aminopropyl)trimethoxysilane (amino-silane). Freestanding films were fabricated via vacuum filtration, yielding binder-free, flexible electrodes suitable for supercapacitor applications. The silane-to-MXene mass ratio was maintained at 3:1. Structural characterization was performed using Fourier-transform infrared spectroscopy (FTIR), X-ray diffraction (XRD), and X-ray photoelectron spectroscopy (XPS). FTIR analysis confirmed the formation of new chemical bonds in the functionalized materials, as evidenced by characteristic peaks from the bonds between MXenes and silanes. XRD patterns indicated an increase in interlayer spacing following silane modification, suggesting successful intercalation and surface grafting. XPS data further confirmed the presence of silicon originating from the silane molecules, supporting the occurrence of covalent functionalization. This structural characterization provides insight into the relationship between the material's structure and its electrochemical behavior, which will be explored in subsequent investigations. The resulting functionalized MXene films demonstrate strong potential for use in flexible energy storage devices, including supercapacitors and wearable electronics.

This research was supported by the University of Belgrade - Institute of Chemistry, Technology and Metallurgy through the "Seed Research Grant" for young scientists ("*Surface Functionalized Niobium-Based MXene Electrodes for Enhanced Capacitance and Energy Storage Performance (SurfMEX)"),* financed by Serbia Accelerating Innovation and Entrepreneurship Project (SAIGE).

P4

Comparison of Interactions and Morphology During Aluminum Fluoride and Water Intercalation in Graphite

Sindy J. Rodríguez[1], Mateja Jovanović[2,3], Miljan Dašić[4], Igor Stanković[4,5]

[1]Instituto de Física del Litoral, Consejo Nacional de Investigaciones Científicas y Técnicas y Universidad Nacional del Litoral (IFIS-Litoral, CONICET-UNL), Santa Fe 3000, Argentina
[2]Institute of Technical Sciences of SASA, Kneza Mihaila St. 35, 11000, Belgrade, Serbia
[3]Freudenberg Technology Innovation SE & Co. KG, Hoehnerweg 2-4, 69469 Weinheim, Germany
[4]Institute of Physics Belgrade, University of Belgrade, Pregrevica 118, 11080 Zemun, Serbia
[5]Departamento de Ingeniería Universidad Técnica Federico Santa María, Av. España 1680, Valparaíso, Chile

Understanding the intercalation behavior of ionic and molecular species in graphite is essential for advancing layered and two-dimensional material applications. In this study, we present a comparative investigation of the structural, energetic, and morphological features associated with the intercalation of aluminum fluoride (AlF_3) and water molecules into graphite. By combining molecular dynamics simulations with density functional theory calculations, we evaluate interlayer spacing, binding energies, and interaction mechanisms of both intercalants within the graphite host. The results reveal distinct intercalation pathways and interfacial morphologies: water molecules induce interlayer swelling and exhibit a homogeneous distribution between graphene sheets, while AlF_3 forms rigid, localized domains stabilized primarily by electrostatic interactions. These contrasting behaviors lead to markedly different structural responses in the graphite matrix. The insights gained from this comparative study offer valuable guidance for the design of graphite-based materials tailored for electrochemical devices and layered composite systems.

We acknowledge funding from the European Union's Horizon Europe research and innovation program under the Marie Sklodowska-Curie project BLESSED grant agreement No-101072578.

P5

Laser-Induced Graphene on Polyurethane/Polyimide Nanoparticle Composites: Tuning the Surface Wettability, Mechanical, and Electrical Characteristics for Flexible Electronics

Vanja Vojnović[1], Marko Spasenović[1], Ivan Pešić[1], Stefan D. Ilić[1], Teodora Vićentić[1],
Danica Bajuk-Bogdanović[2], Marija V. Pergal[1]

[1]Center for Microelectronic Technologies, Institute of Chemistry, Technology and Metallurgy, National Institute of the Republic of Serbia, University of Belgrade, Belgrade, Serbia
[2]Faculty of Physical Chemistry, University of Belgrade, Belgrade, Serbia

Laser-induced graphene (LIG) offers a fast and cost-effective approach for fabricating customizable conductive patterns on polymers, making it suitable for flexible electronics. Among potential substrates, polyurethanes (PUs) stand out due to their tunable properties originating from a wide range of available building blocks for urethane linkages. Nevertheless, the absence of aromatic structures in PUs is challenging for direct laser induction of graphene, and transfer from other materials to PU would be an undesirable fabrication step. To overcome this limitation, we modified the PU matrix via *in situ* polymerization with polyimide nanoparticles (PI NPs), enabling direct laser induction of graphene. We systematically investigated the effects of soft segment content (SSC) and varying PI NPs wt. % on the mechanical properties and wettability of PU/PI composites, as well as on the quality and conductivity of the resulting LIG. Fourier-transform infrared spectroscopy (FTIR) and Raman spectroscopy confirmed the successful synthesis of PU/PI and formation of LIG. Composites containing 50 wt.% SSC and 20 wt.% PI NPs demonstrated an optimal balance between mechanical properties and electrical performance. This study aims to advance the development of LIG/PU/PI materials for piezoresistive sensor applications.

This research was supported by the Science Fund of the Republic of Serbia, #4950, Polymer/graphene heterostructures for physiological sensors—Polygraph.

P6

Basic electrochemical performance of graphene/carbon non-woven composite

Vanja Gujaničić[1,2], Sanja Krstić[3], Danica Bajić[4], Milica Košević[5]

[1]Technical Test Center, Vojvode Stepe 445, 11000 Belgrade, Serbia,
[2]University of Defence, Military Academy, Veljka Lukića Kurjaka 33, Belgrade, Serbia
[3]Institute of General and Physical Chemistry, Studentski trg 12/V, P.O Box 45, 11158 Belgrade, Serbia
[4]Military Technical Institute, Ratka Resanovića 1, 11030 Belgrade, Serbia
[5]University of Belgrade - Institute of Chemistry, Technology and Metallurgy - National Institute of The Republic of Serbia, Njegoševa 12, 11000 Belgrade, Serbia

A novel composite material was prepared by depositing graphene onto non-woven carbon fiber (CNW) to serve as a potential supercapacitor electrode. Its capacitive performance was evaluated in 0.5 M H_2SO_4 using a standard three-electrode setup and cyclic voltammetry (CV) at sweep rates of 500, 200, 100, and 10 mV s^{-1}. The results were compared with those of untreated CNW. The CV curves exhibited characteristic features of electric double-layer capacitance across all sweep rates. Notably, the quasi-rectangular shape of the CV curves was retained even at higher sweep rates, indicating good rate capability of the graphene-coated CNW. The enhanced capacitive behavior of the CNW/graphene composite, in comparison to untreated CNW, is attributed to the high electrical conductivity and large surface area of graphene, which promote efficient charge accumulation at the electrode–electrolyte interface. Overall, these findings highlight the potential of the prepared composite as a promising supercapacitive material for graphene-based energy storage devices.

Acknowledgement: This research has been financially supported by the Ministry of Science, Technological Development and Innovation of Republic of Serbia (Contract No. 451-03-137/2025-03/200325, 451-03-136/2025-03/200051 and 451-03-136/2025-03/200026, and the scientific project of the Military Academy, University of Defense in Serbia (VA-TT/1/22-24). The work is

aligned with the United Nations Sustainable Development Goals #7 - Ensure access to affordable, reliable, sustainable and modern energy for all.

P7

Evolution of Surface Roughness in SLS-Manufactured PA12 Sliding Bearings under Dry Friction Conditions

Ivan Simonovic[1], Aleksandar Marinković[1], Zarko Miskovic[1], Isaak Trajkovic[2], Milos Milosevic[2], Dragan Milkovic[1]

[1]University of Belgrade, Faculty of Mechanical Engineering, Kraljice Marije 16, Belgrade, Serbia
[2]University of Belgrade, Innovation Center of the Faculty of Mechanical Engineering, Kraljice Marije 16, Belgrade, Serbia

This research investigated any changes in surface roughness of polymer sliding bearings produced using Selective Laser Sintering (SLS) before to and following tribological testing under dry friction conditions. Polyamide 12 (PA12) was utilized as the foundational material owing to its advantageous mechanical and thermal characteristics. Bearing samples underwent regulated load and speed settings that replicated actual working circumstances. Surface topography was assessed by contact profilometry, measuring Ra, Rz, and additional roughness parameters both before and after testing. The findings demonstrate a distinct association between the exerted tribological stress and the changes in surface morphology, signifying material smoothing, abrasion, or micro-ploughing contingent upon the testing conditions. This research enhances the comprehension of wear mechanisms in additively made polymer bearings and facilitates the modification of SLS process parameters for improved tribological performance.

Acknowledgement: This research was supported by the Ministry of Science, Technological Development and Innovations of the Republic of Serbia (Contract No. 451-03-137/2025-03/200105, dated 04.02.2025 and Contract No. 451-03-136/2025-03/ 200213, dated 04.02.2025) and CA23155 – A pan-European network of Ocean Tribology (OTC).

P8

How sodium silicate affects self-compacting concrete qualities with various aggregates and mineral additions

Aleksandar R. Savić[1], Miloš Ćurčić[1], Vladimir Dučić[1], Vladimir Radovanović[1], Anja Terzić[2]

[1]University of Belgrade, Faculty of Civil Engineering, Bulevar kralja Aleksandra 73, 11000 Belgrade, Serbia
[2]Institute for Testing of Materials, Bulevar vojvode Mišića 43, 11000 Belgrade, Serbia

Self-compacting concrete (SCC) was developed with the goal of minimizing the human factor in concrete placement. SCC improves the quality and durability of the structures because it does not require vibration after being poured into the formwork and molds. The use of construction and demolition waste (C&DW) as a source of aggregates for the production of new concrete is the result of increasing environmental awareness and responsibility for future generations' lives, as well as recognizing the economic interest expressed through lower transportation costs and avoidance of landfill fees. Given the foregoing, the fact that interest in recycled aggregate (RCA) from concrete waste is steadily increasing is unsurprising, but it is just evidence and an indicative of the future direction of material use. This research investigates the idea of treating recycled aggregates with sodium silicate to improve their qualities in high-strength concrete. Silica fume and fly ash, the industrial byproducts, are used as mineral additives. Throughout the experiment, several different self-compacting concrete compositions were tested. The reference combination was made entirely of natural aggregate, whereas the remaining four mixtures used 50% recycled aggregate in the II (4/8) and III (8/16) fractions. The physical and mechanical properties of fresh and hardened concrete were investigated, as well as the feasibility of employing treated recycled aggregate in high-strength structural concrete. The fresh qualities of concrete were assessed using consistency, entrained air percentage, and concrete temperature. Compressive strength, flexural strength, static and dynamic modulus of elasticity, ultrasonic pulse velocity, adhesion, water impermeability, and surface hardness were all measured in hardened concrete. The results show that there is a possibility of improving properties of fresh and hardened self-compacting concrete with recycled concrete aggregate, paving a way to a more sustainable construction.

P9

Luminescence thermometry of $SrGd_2O_4$: Yb, Tm up-conversion nanoparticles

Tijana Stamenković[1], Ivana Dinić[2], Miloš Tomić[2], Lidija Mančić[2], Vesna Lojpur[1]

[1]Vinča Institute of Nuclear Sciences, Department of Atomic Physics, National Institute of the Republic of Serbia, P.O. Box 522, 11001 Belgrade, University of Belgrade, Serbia
[2]Institute of Technical Science of SASA, Kneza Mihaila 35/IV, Belgrade, Serbia

When employing the remote operation mode, luminescence thermometry is a useful technique for measuring temperature. The modified sol-gel process was used to create a series of Tm^{3+} (1 at%) and Yb^{3+} (2, 4, and 6 at%) doped $SrGd_2O_4$ up-conversion (UC) nanoparticles, which were then thoroughly characterized to optimize their composition and optical characteristics. Regardless of stoichiometry, XRPD, TEM/HRTEM, and STEM/EDS investigation verified the crystallization of single-phase nanoparticles with homogeneous doping in every sample. The ideal sensitizer doping concentration is 4 at%, as demonstrated by the UC emissions obtained under 976 nm excitation, which showed typical Tm^{3+} transitions. For this material, the emission seen in the Vis part of the up-conversion spectra was found to have a lifetime of 342 μs and a total quantum yield of 1.12% at ambient temperature. Its exceptional temperature-sensing capabilities were suggested by the temperature-dependent emission spectra, observed between 263 and 363 K. The blue $I_{479/485}$ and IR $I_{795/807}$ Tm^{3+} emissions were measured using the luminescent intensity ratio (LIR). As the temperature rises, the absolute and relative temperature sensitivity steadily drops, reaching values of 4.05×10^{-3} K^{-1} and 0.41 $\%K^{-1}$ for blue and 3.8×10^{-3} K^{-1} and 0.31 $\%K^{-1}$ for infrared at 300 K.

Acknowledgement: This investigation is supported by The Ministry of Science, Technological Development and Innovation (contract number: 451-03-66/2024-03/ 200012) and Project: 101111694 — GREENCO — ERASMUS-EDU-2022-PI-ALL-INNO.

P10

Preparation of high strength porous silica from monodispersed silica spheres by partially sintering

Kezheng Sang, Zhengyu Sun, Dejun Zeng

School of Materials Science and Engineering, Chang'an University, Xi'an, 710064, China

Porous silicon oxide has been become an ideal choice for casting core materials because of its high strength, high temperature resistance, and hot alkali corrosion resistance. In this project, monodispersed spherical silica particles with the size of several hundreds of nanometers were used as raw materials to prepare porous silica by grouting and partial sintering. The results shew that the silica slurry with a 40% solid content is suitable to form complete green bodies. With the increase of sintering temperatures from 1120 °C to 1320 °C, the porosity of the porous silica decreased from 40.3% to 29.8% meanwhile the compressive strength increased from 4.2 MPa to 42.2 MPa. The microstructure of the porous silica show a uniform pore distribution with a single peak in the range of 200~300 nm. The strength of the porous silica obtained was enhanced by about 54% compared with that reported in other literatures. It was considered that the enhancement of the strength was due to the spherical silica particles used and the sintering mechanism of viscous flow.

P11

Laser-Induced Nanostructuring and Phase Evolution in ZnO: Co Nanomaterials

B. Hadzic[1], M. Curcic[1], I. Kuryliszyn-Kudelska[2], M. Romcevic[1],
W.D. Dobrowolski[2], N. Romcevic[1]

[1]Institute of Physics, University of Belgrade, Pregrevica 118, 11 080 Belgrade, Serbia
[2]Institute of Physics, Polish Academy of Science, al. Lotnikow 32/46,
02-668 Warszawa, Poland

This study investigates the effect of laser-induced heating on ZnO: Co nanocrystalline materials prepared by co-precipitation followed by calcination at 600 °C. The aim was to explore how varying CoO dopant concentrations (5–90%) and different laser power densities influence phase composition, nanostructuring, and surface optical phonon (SOP) behavior. X-ray diffraction (XRD) confirmed the presence of ZnO and $ZnCo_2O_4$ phases in the initial samples. Raman spectroscopy (100–1600 cm^{-1}) revealed laser-induced peak broadening and redshifts, with different effects on ZnO and Co_3O_4-related modes. Surface morphology and structural changes were analyzed via SEM and Raman mapping. Laser irradiation led to local heating without thermal destruction, promoting partial decomposition and the formation of secondary phases such as $Zn_{1-x}Co_xO$, $Zn_\gamma Co_{3-\gamma}O_4$, and Co_3O_4. With increasing dopant content and laser power, a systematic reduction of SOP modes was observed, indicating enhanced nanostructuring and phonon confinement. The results highlight a strong interplay between dopant level, laser power, and phase evolution, demonstrating that controlled laser processing can tailor the structural and vibrational properties of ZnO: Co nanomaterials.

P12

Degradation of Microplastics by Plasma, UV Radiation, and Ozone: FTIR and Raman Spectroscopic Analysis of Polystyrene, Polyethylene, and Polypropylene

M. Ćurčić[1*], P. Kolarž[1], B. Hadžić[1], I. Stajčić[2], Z. Lazarević[1]

[1]Institute of Physics, University of Belgrade, Pregrevica 118, 11080 Belgrade, Serbia
[2]Institute Vinca, University of Belgrade, P.O. Box 522, 11001 Belgrade, Serbia

This study explores the degradation of three prevalent microplastic polymers—polypropylene (PP), polyethylene (PE), and polystyrene (PS)—when subjected to ozone (O_3), ultraviolet (UV) radiation, and cold plasma treatments. These experimental conditions represent distinct oxidative and energetic degradation environments relevant to real-world scenarios, such as environmental exposure and industrial processing. The microplastic samples were systematically treated under controlled laboratory conditions to simulate realistic degradation pathways. Structural and chemical transformations were tracked using Fourier-transform infrared (FTIR) and Raman spectroscopy, which provided complementary insights into changes in molecular bonds and functional groups [1]. The spectroscopic data revealed treatment-specific degradation signatures. Observed changes included the formation of carbonyl and hydroxyl groups, backbone scission, and alterations in crystallinity. These transformations were evident through the appearance, shift, or intensity variation of characteristic peaks, reflecting the progressive breakdown of the polymer structure. By comparing the effects of each treatment across the three polymers, the study highlighted differences in degradation susceptibility and persistence under oxidative and energetic stressors [2]. This multi-technique approach offers valuable insight into microplastic aging and breakdown mechanisms, contributing to a better understanding of their environmental fate and informing strategies for polymer design, environmental remediation, and pollution monitoring.

References:

[1] Alimi, O.S., Farner Budarz, J., Hernandez, L.M., Tufenkji, N., 2018. Microplastics and nanoplastics in aquatic environments: aggregation, deposition, and enhanced contaminant transport. Environ. Sci. Technol. https://doi.org/10.1021/acs.est.7b05559.

[2] Bandaru, S., Ravipati, M., Busi1, K.B., Phukan, P., Bag, S., Chandu, B., Dalapati, G.K., Biring, S., Chakrabortty, S., 2024. A review on the fate of microplastics: their degradation and advanced analytical characterization. J. Polym. Environ. 32, 2532–2550.
https://doi.org/10.1007/s10924-023-03102-7.

P13

Effects of Er^{3+} ion doping on the local structure and photoluminescence of $BaTiO_3$ ceramics

Z. Ž. Lazarević[1], M. S. Rabasović[1], M. Ćurčić[1], I. Stajčić[2], B. Hadžić[1], B. Simović[3], V. Paunović[4]

[1]Institute of Physics - National Institute of the Republic of Serbia, University of Belgrade,
P.O. Box 68, Pregrevica 118, Zemun, Belgrade, Serbia
[2]University of Belgrade, Department of Physical Chemistry, Vinča Institute of Nuclear Sciences,
Mike Petrovića Alasa 12-14, 11351, Vinča, Belgrade, Serbia
[3]University of Belgrade, Institute for Multidisciplinary Research, Belgrade, Serbia
[4]University of Niš, Faculty of Electronic Engineering, Aleksandra Medvedeva 14, Niš, Serbia

Er^{3+}-doped $BaTiO_3$ with a perovskite-type ABO_3 structure was investigated, focusing on the substitution of Er^{3+} ions at both A-sites (Ba) and B-sites (Ti) across various doping levels. The powders were synthesized using a conventional solid-state reaction route, varying both the dopant location and concentration. The obtained powders were compacted into pellets and sintered at 1380 °C. The effectiveness of Er^{3+} incorporation and the resulting material properties were found to be significantly influenced by the sintering parameters. The morphological and optical characteristics of the synthesized materials were examined using SEM, AFM, Raman spectroscopy, and photoluminescence analysis. Changes in the vibrational properties of the $BaTiO_3$ lattice due to Er^{3+} incorporation were studied via Fourier transform infrared spectroscopy. Reflectivity measurements in the far-IR region, combined with attenuated total reflectance FTIR in the mid-IR range, provided comprehensive insight into the full vibrational spectrum of BTO. Morphological analysis and elemental mapping of the sintered surfaces were performed using SEM coupled with energy-dispersive X-ray spectroscopy. The introduction of Er^{3+} into the $BaTiO_3$ lattice induced increased structural disorder and the emergence of additional vibrational modes. A minor red shift in these modes was observed with increasing Er^{3+} concentration (in wt.%), indicating modifications in the local lattice dynamics.

P14

Changes in the Vibrational Characteristics of Clay Samples During the Drying Process

Miloš R. Vasić[1], Filip Pantelić[2], Saša Đelević[2], Miloš Vorkapić[3]

[1]Institute for Testing of Materials, Bulevar Vojvode Mišića 43, Belgrade, Serbia
[2]Academy of Technical and Art Applied Studies, 24 Starine Novaka St., Belgrade, Serbia
[3]University of Belgrade, Institute of Chemistry, Technology and Metallurgy, Njegoševa 12, Belgrade, Serbia

This paper investigates the changes in the mechanical and acoustic properties of clay samples during drying. Variations in resonant behaviour over time were analysed using impulse excitation, with particular focus on the emergence and evolution of the fundamental vibration mode under free boundary conditions. During the drying process, there is a significant decrease in internal damping and an increase in the effective modulus of elasticity, which enables the appearance of clearly

defined resonant frequencies only in the later stages of drying. Due to the relatively large thickness compared to the width of the sample, classical thin plate models are not fully applicable, so the results are interpreted while considering the limitations of the theory. Experimental data indicate that the first vibration mode becomes the dominant signal component only after the sample reaches a certain level of dryness. The results are relevant for the development of a methodology for non-destructive monitoring of the mechanical properties of clay and similar materials during drying.

P15

Liquid Phase Exfoliated Graphene/PDMS hybrid sensor for finger motion tracking

Milena Rašljić Rafajilović[1], Stevan Andrić[1], Danilo Kisić[2], Lazar Rakočević[2],
Danica Bajuk-Bogdanović[3], Dana VasiljevićRadović[1], Marko Spasenović[1]

[1]Institute of Chemistry, Technology and Metallurgy, University of Belgrade, Belgrade, Serbia
[2]Institute of Nuclear Sciences Vinča, University of Belgrade, Serbia
[3]Faculty of Physical Chemistry, University of Belgrade, Belgrade, Serbia

Graphene, a two-dimensional crystalline carbon structure, consists of a single layer of carbon atoms arranged in a hexagonal lattice. Due to its extraordinary properties, including strength, durability, optical characteristics, exceptional electrical and thermal conductivity, and biocompatibility, graphene is utilized in diverse fields such as medicine, electronics, photonics, energy storage devices, environmental applications, and more. In our work, we employed the Langmuir-Blodgett method to deposit a thin conductive graphene layer, derived from electrochemically obtained liquid-phase exfoliated graphene in N-methyl-2-pyrrolidone (NMP), on a poly(dimethylsiloxane) (PDMS) substrate. The PDMS elastomer is a biocompatible, transparent, and flexible material with a wide range of applications, including the development of flexible sensors. This process led to the development of a flexible sensor designed to track finger movements. The layer of graphene was characterized using Raman spectroscopy, XPS, and AFM. Electrical contacts to the sensor were made by sputtering a thin layer of gold. Copper wires were connected to the sensor with silver paste as a connection between the sensor and electrical equipment, which enabled to track changes in electrical resistance with finger movement when the sensor was attached to a human finger. This study shows that a flexible sensor with LPE graphene on a PDMS substrate featuring sputtered electrical contacts yields a stable and precise electrical signal upon finger movement and that this type of sensor can be used to track limb motion.

Acknowledgement: This research was supported by the Science Fund of the Republic of Serbia, #4950, Polymer/graphene heterostructures for physiological sensors – Polygraph. The authors would like to thank the Ministry of Science, Technological Development, and Innovation of Republic of Serbia (Contract No: 451-03-136/2025-03/200026).

P16

Comparison of the properties in single and dual phase (Hf,Ti,Zr)B_2–(Hf,Ti,Zr)C ceramics influenced by transition metal distribution

S. Filipović[1,2], W. G. Fahrenholtz[1], G. E. Hilmas[1], N. Obradović[2], S. Curtarolo[3]

[1]Materials Science and Engineering, Missouri University of Science and Technology, 65049 Rolla, Missouri, United States
[2]Institute of Technical Sciences of the Serbian Academy of Sciences and Arts, 11000 Belgrade, Serbia
[3]Dept. Mechanical Engineering and Materials Science and Center for Extreme Materials, Duke University, 27708 Durham, USA

Mid entropy dual phase ceramics are attractive due to potential synergistic effects of the constituents on functional properties, but with less compositional complexity compared to high entropy systems. Dual phase mid entropy carbide/mid entropy boride ceramics were produced by co-synthesis method followed by two-step spark plasma sintering at 1900 °C or 1950 °C. Derived from transition metal distribution in the dual phase ceramics determined by energy dispersive spectroscopy, individual mid entropy boride and carbide ceramics were produced using the same conditions. The final dual phase microstructures had submicron grains due to the pinning effect of the two phases, while grain sizes of the individual mid entropy carbides and borides had average grain sizes higher than 9 µm and 2 µm, respectively. Vickers hardness value for dual phase ceramics was 43.5 ± 5.1 GPa, while value calculated using a volumetric rule of mixtures was 36.2 GPa. Thermal conductivity of the dual phase ceramic displayed an increase of ~15% compared to the constituent phases, along with ~35% lower electrical resistivity than the value calculated from the individual constituents. Based on Wiedemann–Franz law, fraction of the phonon carriers was close to 25 %, for individual mid entropy borides and it was around 63 % for individual mid entropy carbides, while in the case of the dual phase ceramics, the phonon contribution was approximately 44 % of the total conductivity, indicating that the mid entropy boride phase had a dominant effect on the electrical resistivity of the composite. A synergetic effect between phases resulted in increase in thermal and electrical conductivities along with the hardness of the dual phase ceramics compared to the constituent borides and carbides.

P17

State of the art on low-clinker cements and future roadmap

Anja Terzić[1], Nevenka Mijatović[1], Ljiljana Miličić[1], Biljana Ilić[1], Milica V. Vasić[1], Miloš R. Vasić[1], Ana Kontić[1], Isidora Šušić[1], Zagorka Radojević[1]

[1]Institute for Testing of Materials (Laboratory for Binders, Chemistry, and Mortar; Laboratory for Construction Ceramics; & Certification Body of Institute IMS),
Bulevar Vojvode Mišića 43, 11000 Belgrade, Serbia

The expansion of infrastructural and construction work raises the demand for cement-based binders. The two factors that have the biggest effects on sustainability are cement usage and concrete production. This review study's goal is to provide a pathway for the sustainability

assessment of binders' production in terms of cost, carbon emissions, and energy demand. The performances of geopolymer concrete (GC) and traditional cement-based concrete (NC) are juxtaposed with those of limestone calcined clay cement (LC^3) concrete. The significance of LC^3 in lowering CO_2 emissions in the cement sector is evaluated, along with the raw materials utilized in its production and the material's end characteristics including hydration routes and mineralogy. The economic viability and social acceptability of LC^3 in the building sector, as well as any possible effects on local communities, are also evaluated in the study. According to the assessment, the energy demand and CO_2 emission of NC, GC, and LC^3 concrete can be significantly impacted by the materials chosen for the concrete mix, especially if the alternative raw materials or waste streams are utilized. The primary source of energy consumption and carbon emission in GPC is the alkaline medium, while in NC is OPC production. The LC^3 system is a more economical, energy-efficient, and carbon-efficient material than GC and NC concrete. A discussion of future prospects and research needs, including suggestions for further production innovation and LC^3 production scaling is conducted. According to the review paper's conclusions, LC^3 offers a sustainable and economically feasible substitute for conventional cement materials, with the potential to significantly lower the cement industry's carbon footprint.

Acknowledgement: This investigation is financially supported by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia, NITRA (Contract No.: 451-03-136/2025-03/ 200012). The goal of this work aligns with SDGs (especially SDGs 9, 11, 12, and 13).

P18

Surfactant-Assisted ZnO/GO Composite Electrocatalysts for HER and OER

Katarina Aleksić[1], Ana Stanković[1], Ljiljana Veselinović[1],
Ivana Stojković Simatović[2], Smilja Marković[1]

[1]Institute of Technical Sciences of SASA, Knez Mihailova 35/IV, Belgrade, Serbia,
[2]University of Belgrade - Faculty of Physical Chemistry, St. Trg 12-16, Belgrade, Serbia

The development of efficient (photo)electrocatalysts for the hydrogen evolution reaction (HER) and oxygen evolution reaction (OER) is crucial for advancing water splitting technologies. The increasing demand to replace expensive and scarce platinum group metals (PGMs) has intensified the search for alternative, abundant, and cost-effective catalysts. Zinc oxide (ZnO)-based materials present promising candidates due to their high electron mobility, efficient charge transfer, intrinsic stability, non-toxicity, and environmental compatibility. With the aim of improving the electrocatalytic performance of pristine ZnO, composites with graphene oxide (GO) without and with the aid of two different surfactants, a cationic cetyltrimethylammonium bromide (CTAB, $C_{19}H_{42}BrN$, *Alfa Aesar, Ward Hill, MA, USA*) and non-ionic Pluronic® F127 (Plu, $EO_{106}PO_{70}EO_{106}$, *Sigma-Aldrich*), were synthesized using microwave processing of a $Zn(OH)_2$ precipitate method. The physicochemical properties of synthesized ZnO/GO, ZnO/GO/CTAB, and ZnO/GO/Plu composites were characterized using X-ray powder diffraction (XRD), Fourier Transform Infrared Spectroscopy (FTIR), field-emission scanning electron microscopy (FESEM), UV-Vis diffuse reflectance spectroscopy (DRS), and photoluminescence (PL) spectroscopy. The (photo)electrocatalytic activity of the prepared samples for HER and OER was evaluated by linear

sweep voltammetry (LSV) in both acidic (0.1 M H_2SO_4) and alkaline (0.1 M NaOH) electrolytes. The observed (photo)electrocatalytic performance was correlated with the physicochemical properties of the composites.

P19

Carbon screen-printed electrodes modified with ZnO nanoparticles/surfactant for sensitive electrochemical determination of doxorubicin and diclofenac

Andjela Mitrović Rajić[1], Ivana Stojković Simatović[2], Ana Stanković[1],
Katarina Aleksić[1], Smilja Marković[1]

[1]Institute of Technical Sciences of SASA, Belgrade, Serbia,
[2]University of Belgrade - Faculty of Physical Chemistry, Belgrade, Serbia

Pharmaceuticals such as beta-blockers, antibiotics, nonsteroidal anti-inflammatory drugs, and neuroleptics can often be found in drinking water and therefore pose a risk to public health. Due to their environmental impact, the detection of these pharmaceuticals is of great importance. Electrochemical sensors (ECS) are widely used today because they exhibit high sensitivity, selectivity, and reproducibility. Doxorubicin and Diclofenac are commonly used pharmaceuticals and are therefore frequently detected as water pollutants. In this research, to enhance selectivity and sensitivity of ECS, surface modification of carbon screen-printed electrodes was applied. The carbon screen-printed electrodes were modified with zinc oxide nanoparticles synthesized by microwave processing of precipitate without (ZnO) and with aid of surfactants, precisely with cetyltrimethylammonium bromide (ZnO/CTAB) and Pluronic F127 (ZnO/Plu). The crystal structure, morphology and optical properties of the synthesized materials were analyzed by XRD, FESEM, BET, Raman, UV-Vis DRS, and PL spectroscopy. The qualitative and quantitative detection of Diclofenac (infusion solution, 75 mg DCF / 3 mL, Galenika a.d.) and Doxorubicin (infusion solution, Ebewe Pharma, 50 mg DCF / 25 mL) in water was performed using differential pulse stripping voltammetry. All measurements were performed in 25 mL of phosphate buffer (pH=7) by adding the analyte in precisely defined portions. The obtained results showed that carbon screen-printed electrodes surface modified with zinc oxide-based materials can be effectively used to detect Doxorubicin and Diclofenac as water pollutants with a low limit of detection and quantification. Enhanced electrochemical activity of the surface modified electrodes were attributed to altered crystal structure and morphology of zinc oxide particles.

Acknowledgement: This research was funded by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia (contract nos. 451-03-136/2025-03/200175 and 451-03-137/2025-03/200146). The authors ISS, AS, KA and SM acknowledge the financial support from the Science Fund of the Republic of Serbia, The Program PRISMA, #7377, Water pollutants detection by ZnO-modified electrochemical sensors: From computational modeling via electrochemical testing to real system application – WaPoDe.

P20

Mechanical Performance of 3D-Printed PLA after Artificial Aging

Miloš R. Vasić[1], Snežana Vučetić[2], Vesna Miljić[2], Miloš Vorkapić[3],
Anja Terzić[1], Mladen Ćosić[1], Danica M. Bajić[4]

[1]Institute for Testing of Materials, Bulevar Vojvode Mišića 43, Belgrade, Serbia
[2]University of Novi Sad, Faculty of Technology, Bulevar cara Lazara 1, Novi Sad, Serbia
[3]University of Belgrade, Institute of Chemistry, Technology and Metallurgy, Njegoševa 12, Belgrade, Serbia
[4]Military Technical Institute, Ratka Resanovića 1, Belgrade, Serbia

This study examines the mechanical performance of a 3D-printed PLA quadcopter arm fabricated with reduced infill density and subjected to artificial aging. The aging process simulated real-world environmental exposure through thermal cycling, humidity, UV/IR radiation, and freeze-thaw conditions. Tensile strength testing was conducted to assess mechanical integrity, while FTIR spectroscopy, colorimetric analysis, and wettability measurements were employed to evaluate material degradation. Despite a notable reduction in mechanical strength, the component maintained functional performance throughout the testing period. Numerical simulations further supported the experimental findings by identifying stress concentration zones and the onset of plastic deformation. Importantly, even after aging and with a low infill density of 30%, the quadcopter arm demonstrated the ability to withstand a load of 2.0 kg. These results highlight the potential of low-infill PLA components for use in lightweight and cost-effective drone applications, where both mechanical resilience and material efficiency are critical.

P21

Characterisation of BCZT Powders after Milling and Subsequent Thermal Treatment

Darko Kosanović[1], Nebojša Labus[1], Adriana Peleš Tadić[1], Vladimir B. Pavlović[2],
Maja Jović[1], Ana Stanković[1], Jelena Živojinović[1]

[1]Institute of Technical Sciences of the Serbian Academy of Sciences and Arts, Knez Mihailova 35/IV, 11000 Belgrade, Serbia
[2]University of Belgrade, Faculty of Agriculture, Nemanjina 6, Belgrade, 11080, Serbia

$(Ba_{0.90}Ca_{0.10})(Zr_{0.10}Ti_{0.90})O_3$ (BCZT) powders were synthesized via high-energy ball milling and subsequent solid-state reaction, starting from commercial $BaCO_3$, $CaCO_3$, TiO_2, and ZrO_2 powders. The high-energy ball milling was performed in air for various durations. The milled powders were then thermally treated under non-isothermal conditions up to 1300 °C. The powders were characterized using X-ray diffraction (XRD), scanning electron microscopy with energy-dispersive spectroscopy (SEM/EDS), and particle size analysis (PSA). Thermal behavior during heating was examined using thermogravimetric/differential thermal analysis (TGA/DTA) in air. After compaction, sintering of the powders was monitored using dilatometry. The objective of this

study was to investigate the influence of milling on the phase development, thermal behavior, and microstructural evolution during subsequent heating.

P22

Epoxy-based sandwich composites reinforced with carbon nanostructures for multispectral camouflage applications

Sara Pepić, Danica Bajić, Olga Maraš, Jelena Gržetić, Aleksandar Ćitić,
Aleksandar Milojković, Dragan Knežević

Military Technical Institute, Ratka Resanovića 1, 11030 Belgrade, Serbia

This work presents the design and characterization of multifunctional sandwich composite structures, for the potential application in multispectral camouflage protection. The proposed materials include carbon nanostructures in a polymer matrix, to achieve tailored optical, thermal, and mechanical performance. The composite configuration consists of carbon fabric top and bottom sheets and an aramid honeycomb core, bonded using an epoxy resin system. The epoxy system was applied as neat, with no additives, and as modified, with addition of graphite and carbon nanofibers, as carbonaceous ceramic materials known for their high thermal conductivity and electromagnetic attenuation properties. The influence of these nanostructures on the composite's mechanical resistance was observed by impact test, and camouflage capability was investigated in UV VIS and IR part of the spectrum. The obtained results have confirmed positive effect of the carbon structures on the materials' camouflage capabilities and improved absorption of impact energy. The incorporation of carbon ceramics into the matrix not only improves functional properties but also provides a lightweight solution suitable for advanced defense applications. These findings highlight the potential of polymer–ceramic hybrid systems in next-generation multispectral camouflage technologies.

Acknowledgement: This work was supported by the Ministry of science, technological development and innovations (Serbia), Contract 451-03-137/2025-03/200325.

P23

Evaluation of biological properties of dental composite materials after aging

Nikola Živković[1], Miloš Lazarević[1], Ivana Dinić[2], Marina Vuković[2],
Lidija Mančić[2], Aleksandra Milić-Lemić[1]

[1]School of Dental Medicine, University of Belgrade, dr Subotica 8, 11000, Belgrade, Serbia
[2]Institute of Technical Sciences of SASA, Kneza Mihaila St. 35, 11000, Belgrade, Serbia

Additive manufacturing (3D printing), and subtractive manufacturing (milling), are two primary processes used today in dental restorations, where 3D printing emerged as a most advanced one. Recent *in vivo* studies have shown good mechanical and physical properties of 3D printed dental materials, but their biological properties, as well as their compatibility with the oral environment, remain incomplete. This type of material contains a higher amount of resin matrix and a lower filler

content, comparing to traditionally used light-cured resin. This increases the risk of monomer release and may provoke a pulp inflammation. The release of monomers mainly depends on the composition of the material. The current work presents results of biocompatibility testing for three commercially available dental composite materials: breCAM HIPC (for milling), CROWNTEC (for 3D printing) and GC G-ænial A'CHORD (for light-curing). Their cytotoxicity was evaluated before and after artificial aging through testing on human gingival fibroblast cells. The results obtained were corelated to the surface chemistry of the resins and the degree of monomer conversion, which was determined by using Fourier transform infrared spectroscopy (FTIR).

P24 **Poster Session II**

Structural, electrical and hydrophobic properties of LIG/PDMS/TritonX-100 composites with potential application in flexible electrodes

Milena Rašljić Rafajilović[1], Marko Spasenović[1], Teodora Vićentić[1],
Danica Bajuk-Bogdanović[2], Igor Pašti[2], Sanja Ostojić[3], Marija V. Pergal[1]

[1]Institute of Chemistry, Technology and Metallurgy, University of Belgrade, Belgrade, Serbia
[2]Faculty of Physical Chemistry, University of Belgrade, Belgrade, Serbia
[3]Institute of General and Physical Chemistry, University of Belgrade, Belgrade, Serbia

In 2014, a group of authors proposed a novel technique for creating a 3D porous graphene structure on commercial polyimide using a CO_2 laser, referred to as laser-induced graphene (LIG). As a promising material with high carrier mobility, a three-dimensional porous structure, a large surface-to-volume ratio, and excellent mechanical properties, LIG offers a wide spectrum of applications in the physical, chemical, and engineering fields. LIG is well known for being cost-effective and environmentally friendly. This has prompted interest in its application across diverse areas such as energy storage, sensing, and flexible electronics. Due to a lack of stretchable polymers suitable for laser graphenization, our group has successfully synthesized novel polymeric materials and LIG on their surfaces using a CO_2 laser with optimal laser parameters (scanning speed, power, and resolution). We used various contents of Triton X-100 (1-30 wt.%) within a poly(dimethylsiloxane) (PDMS) matrix to prepare LIG with optimal electrical characteristics. The materials PDMS/Triton X-100 and LIG/PDMS/Triton X-100 were analyzed with Raman spectroscopy, ATR-FTIR spectroscopy, SEM/EDX, XRD, TGA, and DSC. The mechanical properties of LIG/PDMS/Triton X-100 were characterized using nanoindentation. We measured hydrophobicity using water contact angle, while the electrical properties of LIG were characterized with four-probes. XRD analysis confirmed the formation of LIG, while Raman spectroscopy revealed a dependence of LIG quality on Triton content. DSC and TGA indicated that Triton X-100 content influenced the thermal stability of the materials. SEM images revealed the typical porous surface morphology of LIG. We found that flexible polymer materials with more porous, hydrophobic graphene and lower sheet resistance were produced as the Triton content increased (up to 30 wt.%). These properties are advantageous for the application of LIG/PDMS/Triton X-100 composites as flexible electrodes.

Acknowledgement: This research was supported by the Science Fund of the Republic of Serbia, #4950, *Polymer/graphene heterostructures for physiological sensors* – Polygraph. The authors would like to thank the Ministry of Science, Technological Development, and Innovation of Republic of Serbia (Contract No: 451-03-136/2025-03/200026).

P25

Humidity sensor based on interdigital electrodes coated with MXenes

Milena Rašljić Rafajilović, Olivera Živković, Ivan Pešić,
Marija V. Pergal, Marko V. Bošković

Institute for Chemistry, Technology and Metallurgy, Center for Microelectronic Technology,
University of Belgrade, Belgrade, Serbia

Interdigital sensors consist of electrodes arranged in a comb-like configuration on a platform, usually covered with a thick conductive layer. These devices provide multiple benefits such as smaller size and cost efficiency. They guarantee quick response times, improve the signal-to-noise ratio, and minimize the ohmic drop. Their unique configuration enables a fast, steady-state current response. Due to their beneficial properties, interdigital electrodes are used in various fields, including biology, sensing, and environmental and industrial applications. In our previous work, we presented the fabrication of interdigital electrodes made of gold on a silicon platform, which are patterned with the standard photolithography processes. In this work, a conductive layer, a thin film of MXenes, was applied, which was formed on the interdigital electrodes using the drop-cast method. Copper wires were connected to the interdigital sensor using silver paste, serving as a connection for resistance measurement. This assembly served as a humidity sensor. The MXene layer was characterized by Fourier Transform Infrared spectroscopy (FTIR) and Scanning Electron Microscopy (SEM) analysis, and electrical characterization of the sensor was performed. A fabricated interdigital sensor and a reference sensor were placed in a glass vessel where the relative humidity level was controlled. The flow of humid gas was gradually increased from 0 ml/min to 100 ml/min in increments of 10 ml/min every 10 minutes, while the flow of dry gas, nitrogen (N_2), was decreased from 100 ml/min to 0 ml/min over the same time interval. The humid gas was generated by passing nitrogen through water. Upon reaching 92% relative humidity, the flow of humid gas was reduced, while the flow of dry gas was increased in the same path, at a rate of 10ml/min every 10 minutes. This cycle was repeated three times. Measurements were conducted at ambient temperature. Throughout the experiment, changes in humidity and resistance were measured and recorded. Results showed that the fabricated sensor is fast and demonstrates excellent reproducibility.

Acknowledgement: The authors would like to thank the Ministry of Science, Technological Development, and Innovation of Republic of Serbia (Contract No: 451-03-136/2025-03/200026).

P26

Effect of Stirring Rate on Morphology and Chlorpyrifos Adsorption Efficiency of Silica Material SBA-15

Maja Kokunešoski[1], Tamara Lazarević-Pašti[1], Tamara Tasić[1],
Aleksandar Jovanović[2], Vedran Milanković[1]

[1]University of Belgrade, Vinca Institute of Nuclear Sciences, National Institute of the Republic of Serbia, Mike Petrovća Alasa12-14, 11351 Vinča, Belgrade, Serbia
[2]University of Belgrade, Faculty of Physical Chemistry, Studentski trg 12-16, 11158 Belgrade, Serbia

Silica material SBA-15 was synthesized under acidic conditions using Pluronic P_{123} as a template. This study focused on how variations in stirring rate during the final synthesis step influence the morphological characteristics and adsorption efficiency of the resulting material. Stirring speeds ranging from 200 to 800 rpm were applied, and the resulting materials were characterized by scanning electron microscopy (SEM), X-ray diffraction (XRD), and Fourier-transform infrared spectroscopy (FTIR). SEM analysis showed that at 200 rpm, the product primarily consisted of elongated rod-shaped particles, with few spherical grains (about 1 μm). As the stirring rate increased, the proportion of spherical particles significantly rose. At 800 rpm, almost all particles exhibited a spherical morphology, with diameters ranging from 2 to 6 μm. The adsorption performance of these materials was evaluated through batch adsorption experiments using chlorpyrifos (initial concentration of 5×10^{-5} mol dm^{-3}) and an adsorbent dose of 1 mg mL^{-1}. After 1 hour of contact, all samples showed similar adsorption efficiencies regardless of stirring rate, with chlorpyrifos removal ranging from 12.3% to 13.6%. These results indicate that while synthesis conditions strongly affect SBA-15 morphology, particle shape and size variations had minimal impact on chlorpyrifos adsorption under the given experimental conditions.

P27

Mechanochemical synthesis of ternary nickel cobalt sulfides as electrocatalysts for hydrogen evolution reaction

Tihana Mudrinić[1,2,4], Magdaléna Strečková[2], Alexandra Gubóová[2], Cyril Bera[2],
Akbar Hussain[3], Imelda Octa Tampubolon[4], Matej Baláž[4]

[1]University of Belgrade Institute of Chemistry, Technology and Metallurgy National Institute of the Republic of Serbia, Njegoševa 12,11000 Belgrade
[2]Institute of Materials Research SAS, Watsonova 47, 040 01 Košice, Slovak Republic
[3]Department of Chemistry, Quaid-i-Azam University, Islamabad-45320, Pakistan
[4]Institute of Geotechnics SAS, Watsonova 45, 040 01 Košice, Slovak Republic

Making hydrogen production more practical and accessible for widespread use requires electrocatalysts that are not only efficient but also sustainable for the hydrogen evolution reaction (HER) in alkaline conditions. With this in mind, we explored an ultrafast mechanochemical method based on mechanically induced self-propagating reactions (MSR) to synthesize cost-effective Ni-

Co-S catalysts using a high-energy ball milling of the elemental precursors in a short time. The obtained materials were deposited onto glassy carbon electrode in the form of ink and systematically evaluated for HER activity via linear sweep voltammetry, electrochemical impedance spectroscopy, and chronoamperometry. For comparison, monometallic NiS and CoS were also synthesized and tested. Among Ni-Co-S, $Ni_{0.4}Co_{0.6}S$ exhibited the best HER performance, with the lowest overpotential, highest exchange current density, and the largest electrochemically active surface area. Compared to NiS and CoS, $Ni_{0.4}Co_{0.6}S$ showed superior HER activity and was synthesized in less time using cheaper milling equipment, respectively. Its performance was not only dominant among tested samples but also competitive with other reported non-precious metal-based HER catalysts. Furthermore, $Ni_{0.4}Co_{0.6}S$ can be synthesized in just 30 seconds, without using toxic solvents or complex steps. These findings demonstrate that MSR offers a rapid, sustainable, and scalable approach for producing efficient HER electrocatalysts.

Acknowledgment This research has been financially supported by the Ministry of Science, Technological Development and Innovation of Republic of Serbia (Contract No: 451-03-136/2025-03/200026). The support of the Scientific Grant Agency of the Ministry of Education, Science, Research and Sport of the Slovak Republic VEGA (2/0112/22, 1/0057/25, and 2/0027/23) and the Slovak Research and Development Agency (project APVV-20-0299) is also acknowledged. The work was carried out during a research stay in Slovakia funded by the National Scholarship Programme of the Slovak Republic, administered by SAIA, n. o. (scholarship ID 52082). The research contributes to the achievement of the United Nations Sustainable Development Goals, specifically Goals 7 (Affordable and Clean Energy), 9 (Industry, Innovation and Infrastructure), 12 (Responsible Consumption and Production), and 13 (Climate Action).

P28

Chemical Degradation of Lime-Based Mortars under Freeze-Thaw Conditions: ICP-OES as a Tool for Assessing Durability

Nevenka Mijatović, Ana Kontić, Isidora Šušić, Biljana Ilić, Ljiljana Miličić

Institute for Institute for Testing of Materials, Bulevar vojvode Mišića 43,
11000 Belgrade, Serbia

Freeze-thaw cycles pose a significant challenge to the long-term stability of mortar materials, particularly in variable climates. This study examines the chemical degradation of historical mortars and three reconstructed types: pure lime mortar, lime mortar with metakaolin, and lime mortar with zeolite as pozzolanic additives. Samples were saturated with deionized water and exposed to up to 15 freeze-thaw cycles (−20 °C / +50 °C). After every five cycles, the samples were rinsed with deionized water, and leachates were analyzed by ICP-OES to quantify Ca, Mg, Si, Al, and Fe concentrations, which serve as indicators of chemical degradation. Increased Ca^{2+} and other ion concentrations in the leachates indicate binder phase breakdown, especially in historical mortars, where a significant release of calcium ions occurred. In contrast, mortars with metakaolin and zeolite showed better chemical stability, with lower losses of Ca^{2+} and other analytes. This enhanced resistance is attributed to the lower porosity and improved water resistance of pozzolanic mortars. The findings indicate that mortars with pozzolanic additives exhibit greater resistance to freeze-thaw cycles, highlighting their significant potential for application in cultural

heritage restoration and in modern construction materials exposed to climate change. ICP-OES analysis has proven effective for monitoring chemical degradation, providing a precise method for assessing long-term mortar resistance.

Acknowledgements: This investigation is supported by The Ministry of Science, Technological Development and Innovation (contract number: 451-03-136/2025-03/200012)

P29

Laser-induced graphene on poly(dimethylsiloxane)/poly(ethylene glycol) substrate for heart rate monitoring sensors

Anđela Gavran[1], Marija V. Pergal[1], Teodora Vićentić[1], Igor Pašti[2,3], Stefan Ilić[1],
Marko Bošković,[1] Marko Spasenović[1]

[1]Center for Microelectronic Technologies, Institute of Chemistry, Technology and Metallurgy,
University of Belgrade, Belgrade, Serbia
[2]University of Belgrade - Faculty of Physical Chemistry, Belgrade, Serbia
[3]Serbian Academy of Sciences and Arts, Belgrade, Serbia

Flexible, wearable sensors based on laser-induced graphene (LIG) have been the subject of research in medicine and sport for a decade. In the search for the optimal polymer substrate for LIG, the focus has been on materials with high carbon concentration, thermal stability, flexibility, strong adhesion and good biocompatibility. Poly(dimethylsiloxane) (PDMS) is the most popular elastomeric material, but pure PDMS cannot fulfill these requirements. In this work, PDMS was modified with high molecular weight poly(ethylene glycol) (PEG), resulting in a carbon-rich, biocompatible and flexible material. PDMS/PEG with varying PEG content (20–40 wt%) and different amounts of PDMS (3–10 g) was used as a substrate for LIG. The laser processing parameters were optimized to achieve the highest quality graphene. Physicochemical properties were characterized with electrical and mechanical investigations, Fourier transform infrared (FTIR) and Raman spectroscopy and scanning electron microscopy with energy dispersive X-ray analysis (SEM/EDX). The functionality of the material was demonstrated by using it as a heart rate sensor. Our work shows promising results for the future of LIG on biocompatible polymers used for medical and recreational purposes.

This research was supported by the Science Fund of the Republic of Serbia, #4950, Polymer/graphene heterostructures for physiological sensors – Polygraph.

P30

Effect of reaction temperature on Oxone®-induced Orange G degradation using Mg-doped Co/alumina catalysts

Sanja Marinović, Marija Ajduković, Nataša Jović-Jovičić, Gordana Stevanović,
Jovan Parlić, Tatjana Novaković

University of Belgrade, Institute of Chemistry, Technology and Metallurgy, Department of
Catalysis and Chemical Engineering, Njegoševa 12, 11000 Belgrade, Republic of Serbia

Two Mg-doped Co/alumina catalysts were synthesized using the sol-gel method. Aluminum alkoxide served as the precursor for preparing boehmite sols. To obtain the Co-Mg/Al composite, $Co(NO_3)_2{\cdot}6H_2O$ and $Mg(NO_3)_2{\cdot}6H_2O$ were added to the freshly prepared sol in quantities corresponding to 0.4 mol of Co^{2+} and 0.03 mol of Mg^{2+} per 1 mol of Al^{3+}. The doped boehmite sol was allowed to gel for 24 hours at 40 °C, followed by an additional 24 hours at 100 °C. The resulting gels were then calcined at 500 °C and 1000 °C for 5 hours, and the final materials were designated MgCoA-500 and MgCoA-1000, respectively. Both catalysts were evaluated for their performance in the oxidative degradation of the textile dye Orange G, using Oxone® as a source of sulfate anion radicals. The influence of temperature on degradation efficiency was investigated over a range from 30 °C to 60 °C. MgCoA-1000 consistently exhibited higher catalytic activity compared to MgCoA-500 under all conditions tested. Furthermore, an increase in temperature led to an enhanced degradation rate for both catalysts. In conclusion, both Mg-doped Co/alumina catalysts demonstrated effective catalytic activity in the degradation of Orange G in the presence of Oxone®, with MgCoA-1000 showing superior performance.

Acknowledgement: This research was financially supported by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia (Contract No: 451-03-136/2025-03/200026).

P31

Influence of chemical composition of Fe-Ni-based amorphous alloys on thermal stability, mechanism and kinetic of crystallization

Milica M. Vasić[1], Radoslav Surla[2], Bojana Milićević[3], Dragica M. Minić[1]

[1]University of Belgrade - Faculty of Physical Chemistry, 11000 Belgrade, Serbia
[2]Military Technical Institute, 11000 Belgrade, Serbia
[3]Centre of Excellence for Photoconversion, Vinča Institute of Nuclear Sciences - National
Institute of the Republic of Serbia, University of Belgrade, 11000 Belgrade, Serbia

Amorphous Fe-Ni-based alloys have been attracting great scientific attention due to their multifunctionality resulting from their isotropic structure and functional properties. Since amorphous alloys are thermodynamically and kinetically metastable, they tend to transform to more stable forms under extreme conditions or even during prolonged application under mild conditions. This occurs through the processes of structural relaxation, crystallization and

recrystallization, which can affect their favorable functional properties. In this work, three Fe-Ni-based amorphous alloys prepared by melt-spinning, namely $Fe_{40}Ni_{38}Mo_4B_{18}$, $Fe_{40}Ni_{40}B_{12}Si_8$, and $Fe_{40}Ni_{40}P_{14}B_6$, were studied regarding their thermal stability, mechanism and kinetics of thermally induced structural transformations. For this purpose, the methods of microstructural and thermal analysis were applied. Crystallization kinetic triplets of individual phases were determined for the studied systems, which can be used for kinetic predictions, with a view to tailoring materials with targeted properties. Variations in chemical composition of the studied alloys were observed to significantly affect their thermal stability, mechanism and kinetics of crystallization, and thus their applicability as functional materials.

P32

Applicability of the gamma vanadium oxide as a cathode of aqueous rechargeable multivalent ion batteries

Milica M. Vasić[1], Miloš Milović[2], Mirjana Novaković[2], Danica Bajuk Bogdanović[1], Dragana Jugović[3], Milica Vujković[1]

[1]University of Belgrade - Faculty of Physical Chemistry, Studentski trg 12-16, 11000 Belgrade, Serbia
[2]Vinča Institute of Nuclear Sciences - National Institute of the Republic of Serbia, University of Belgrade, 11000 Belgrade, Serbia
[3]Institute of Technical Sciences of SASA, Knez Mihajlova 35/IV, 11000 Belgrade, Serbia

The gamma vanadium oxide polymorph phase was prepared via classical solid-state method. The XRD and electron microscopy characterizations revealed orthorhombic *Pnma* gamma crystal structure of the material which built agglomerates consisting of multiple sheets. The prepared gamma vanadium oxide was studied electrochemically as a potential candidate for the cathode material of aqueous rechargeable batteries based on multivalent ions (Mg^{2+}, Ca^{2+} and Al^{3+}). Deeper insight into the effects of electrochemical processes on the electrode structure was gained by comparing the structural information corresponding to the starting host material with those obtained by *ex-situ* XRD, SEM and vibrational spectroscopy analyses of the material subjected to electrochemical measurements. The host material stabilized in Mg^{2+} and Ca^{2+} electrolytes remained stable in a wide range of potentials during the short-term cycling, representing an advantage compared to the behavior in Li^+ electrolyte. The proton co-insertion was found to facilitate the redox processes and activation of the host material in bivalent electrolytes. The best performance including high specific capacity and good cycling stability was observed in Ca^{2+} electrolyte, suggesting gamma vanadium oxide as a prospective candidate for the cathode of aqueous rechargeable Ca^{2+} ion batteries.

P33

Incorporation of boron nitride nanoceramic as a functional additive in polyurethane coatings

Danica Bajić[1], Teodora Stančić[1], Aleksandar Milojković[1], Aleksandra Samolov[2],
Miloš Pavić[1], Miloš Vorkapić[3], Miloš Vasić[4]

[1]Military Technical Institute, Ratka Resanovića 1, 11030 Belgrade, Serbia
[2]"Vinča" Institute of Nuclear Sciences, Institute of National Importance for the Republic of Serbia, Department of Nuclear and Plasma Physics, University of Belgrade, Belgrade, Serbia
[3]University of Belgrade, Institute of Chemistry, Technology and Metallurgy, National Institute of Republic of Serbia, 11000 Belgrade, Njegoševa 12, Serbia
[4]IMS Institute, Bulevar vojvode Mišića 43, 11040 Belgrade, Serbia

Boron nitride (BN), as a ceramic material with high hardness, thermal conductivity, chemical stability, and low density, offers promising multifunctional benefits in role of reinforcement incorporated into polymeric matrices. This study explores the possibility of addition of boron nitride nanoparticles into a polyurethane-based coating at concentrations of 1 wt.% and 2 wt.%, with the aim of enhancing mechanical durability and evaluating the resulting optical characteristics. Coatings were tested for impact resistance, abrasion resistance, and spectrophotometric properties within the visible and near-infrared (NIR) spectrum. The addition of nano-BN led to expected improvements in both impact and abrasion resistance, attributed to the ceramic's inherent mechanical properties. Spectrophotometric analysis revealed minimal shifts in reflectance, indicating a slight brightening effect. These findings highlight the potential of nano-ceramic additives such as BN for multifunctional enhancements in advanced coating systems, regarding structural performance and optical properties.

P34

Characterization of biochar-alumina composites obtained by catalyzed pyrolisis of oak sawdust

Nataša Jović-Jovičić[1], Tatjana Novaković[1], Marija Ajduković[1], Natalia Czerwinska[2],
Maria Letizia Ruello[2], Zorica Mojović[1]

[1]University of Belgrade – Institute of Chemistry, Technology and Metallurgy, Department of Catalysis and Chemical Engineering, Njegoševa 12, 11000 Belgrade, Serbia
2Università Politecnica delle Marche UnivPM - Department of Materials, Environmental Sciences and Urban Planning SIMAU, via Brecce Bianche 12, Ancona, Italy

Biochar refers to a solid product similar to charcoal, produced through the pyrolysis of biomass in a total or partial absence of oxygen. Beside the effects of the raw material, the parameteres of pyrolysis such as heating rate, tempearture and duration of carbonization, applied atmosphere greatly affects the properties of the final product. The investigation of various activators added before or after carbonization of biomass on the properties of the final product was also investigated.

In this research biochar-alumina composites obtained through catalysed pyrolisis of biomass were investigated. The oak sawdust was used as a raw material, while two types of alumina (anhydrous (A) and trihydrate (T) alumina) were used as catalyst. The sawdust was mixed and grounded with catalyst in mass ratios: 1:1, 2:1 and 10:1 and pyrolised in the air limited atmosphere at 400 °C for 1 h. The obtained composites were charaterized by low-temperture N_2 physisorption, SEM and electrochemical methods.

The obtained results showed that the type of alumina and of the sawdust/catalyst ratio had significant effect on the final properties of the material. The possibility for application of these materials for electroanalytical purpose will be investigated.

Acknowledgement: This research has been financially supported by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia (Contract No: 451-03-136/2025-03/200026). This article is based upon work from COST Action EU-PoTaRCh (CA22155, https://potarch.eu) supported by COST (European Cooperation in Science and Technology, (www.cost.eu)).

P35

The influence of preparation method on the properties of ZnO-MgO composites

Milica Carević[1], Nadica Abazović[1], Mirjana Čomor[1], Tatjana Novaković[2], Zorica Mojović[2]

[1]Vinča Institute of Nuclear Sciences, University of Belgrade, National Institute of the Republic of Serbia, P.O box 522, Belgrade, Serbia
[2]University of Belgrade – Institute of Chemistry, Technology and Metallurgy, Department of Catalysis and Chemical Engineering, Njegoševa 12, 11000 Belgrade, Serbia

Metal-oxide nanoparticles are interesting research topic due to their versatility, stability, and potential to enable greener technologies. Zinc oxide–magnesium oxide (ZnO-MgO) composites provide interesting new routes for investigation because of easy tunability of physical and chemical properties. In this research the the influence of preparation method on the properties of resulting ZnO-MgO composite was investigated. Starting from nitrate salts of Zn and Mg, ZnO-MgO compostes with molar ratio Zn:Mg = 1:1 were synthesized by alkaline precipitation method, sol-gel method and hydrothermal preparation method. The materials were calcined at 600 °C for 30 minutes. The obtained composites are charaterized by Diffuse reflectance UV-Vis spectroscopy and electrochemical characterization methodes (cyclic voltammetry, electrochemical impedance spectroscopy, Mott-Schotky analysis). The obtained results were used for determination of flat-band potential and heterogeneous electron transfer rate constant. The resaults indicated the dependence of composite properties on the synthesis procedure.

Acknowledgement: This research has been financially supported by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia (Contract No: 451-03-136/2025-03/200026 and 451-03-136/2025-03/200017).

P36

Modelling of Ar^+ ions in Ar gas

Željka Nikitović, Zoran Raspopović

Institute of Physics, University of Belgrade, Pregrevica 118, 11080 Belgrade, Serbia

Cold plasmas are frequently used in new technologies where they open up the possibilities of non-intrusive production or modification of various substances. In this work we present a cross sections dataset and transport coefficients of Ar^+ ions in Ar gas. Transport of Ar^+ plays significant role in various etching and deposition processes in dark matter detection and many more applications. It is known that transport parameters A Monte Carlo method is applied to accurately calculate transport parameters for the hydrodynamic regime. We discuss new data for Ar^+ ions in Ar gas where the drift velocity, characteristic energy, flux and bulk values of reduced mobility, longitudinal diffusion coefficients, rate coefficients and other transport parameters are given as a function of low and moderate reduced electric fields E/N (E-electric field strength, N-gas number density).

P37

Colossal permittivity of sintered $BaFe_{12}O_{19}$ doped with SiO_2 in the very low frequency region

Stanko O. Aleksić[1], Nina N. Obradović[2], Darko A. Kosanović[2], N. S. Starčević[1], M. P. Gloginjić[1], Milica G. Kisić[3]

[1]Institute of Nuclear Sciences, Vinča, Mihajla Petrovića Alasa 12-14, 11000, Belgrade, Serbia
[2]Institute of Technical Sciences of SASA, Kneza Mihaila 35/IV, 11000 Belgrade, Serbia
[3]Faculty of Technical Sciences, Univerity of Novi Sad, Trg Dositeja Obradovića 6-12, Serbia

Barium hexaferrite $BaFe_{12}O_{19}$ composition was prepared by using the respective powder mixture of metal oxides $BaCO_3:6\cdot Fe_2O_3$ and performing a solid-state reaction at 1000 °C/4h in air. The obtained barium hexaferrite was milled for a prolonged time in the planetary ball mill and agate mill to achieve fine powder of submicron particle size. The prepared powder was characterized by using XRD and SEM techniques. The $BaFe_{12}O_{19}$ submicron powder was mixed with 2,5 % wt. SiO_2 nanopowder as a dopant. After that, the barium hexaferrite powder mixture was pressed into small and thin disk samples at 0,2 GPa. The prepared disk samples were sintered at different sintering profiles from 1050 °C to 1275°C / 2h to 6h in air. The sintered samples were also characterized by using XRD and SEM. The main electrical properties such as disk capacitance C and resistance R at 1Hz to 100 Hz were measured by low frequency impedance analyzer. The dielectric permittivity ϵ_r and dissipation factor tgδ were calculated from the equivalent electrical schemes of disk capacitor. The obtained results were used for observing space charge relaxation effects and colossal permittivity.

P38

The effect of cobalt loading on efficiency of hybrid Co-Al-carbon-smectite catalysts in process of advanced oxidative degradation of Acid Orange 10 in presence of Oxone®

Jovan Parlić[1], Sanja Marinović[1], Marija Ajduković[1], Bojana Nedić-Vasiljević[2],
Predrag Banković[1], Nataša Jović Jovičić[1]

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

Four Co-supported hybrid Co-Al-carbon-smectite catalysts were synthetized and tested in catalytic reaction of oxidative degradation of azo-dye Acid Orange 10 (AO10) in presence of Oxone®. Catalysts were obtained by simultaneously intercalation of Al-Keggin and $HDTMA^+$ cation on 2μm fraction of the smectite clay, and impregnated with different amount of Co^{2+} ions form cobalt-acetate in mass-ratio of 1%, 3%, 5%, and 10%. Finally, the obtained samples were submitted to heat treatment in Ar atmosphere at 400 °C and denoted as 1-Co-Al/H-S, 3-Co-Al/H-S 5-Co-Al/H-S and 10-Co-Al/H-S. The samples were characterized using Inductively coupled plasma - optical emission spectrometry (ICP–OES), FT-IR spectroscopy and X-ray powder diffraction. The UV-VIS spectroscopy was applied to monitor the concentration of AO10 during the degradation process at λ_{max}=478 nm. The degradation percentage in 4 h for catalysts 1-Co-Al/H-S, 3-Co-Al/H-S, 5-Co-Al/H-S and 10-Co-Al/H-S were 62.1%, 84.1%, 94.4%, and 95.1% respectively. The results show that the catalysts 5-Co-Al/H-S and 10-Co-Al/H-S exhibit similar degradation percentages for this reaction. Based on these findings, it can be concluded that 5% Co^{2+} is the optimal impregnation loading for this reaction.

Acknowledgement This research has been financially supported by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia (Contract No: 451-03-136/2025-03/200026).

P39

Optimization of Ceramic Tile Properties Using CERADIT+ Additive: A Phosphate- and Sodium Silicate-Based Binder for Fast Firing

Milica Vidak Vasić[1], Zoran Bačkalić[2], Berta Barta Holló[3], Đorđe Jovanović[4],
Siniša Sremac[5]

[1]Institute for Testing of Materials IMS, Bulevar vojvode Mišića 43, 11000 Belgrade, Serbia
[2]Metropolitan University, Tadeuša Košćuška 63, 11158 Belgrade, Serbia
[3]University of Novi Sad, Faculty of Sciences, Department of Biochemistry and Natural Product Chemistry, Trg Dositeja Obradovića 3, 21000 Novi Sad, Serbia
[4]Faculty of Management, Njegoševa 1A, 21205 Sremski Karlovci, Serbia
[5]Tramaxion d.o.o., Almačka 30, 21000 Novi Sad

This study investigates the effects of CERADIT+, a mixed phosphate- and sodium silicate-based additive, on ceramic tile production during a 50-minute cold-cold firing cycle. The additive, used in quantities up to 0.50%, demonstrated its role as a firing binder, with optimal mechanical properties observed at a 0.15% share under laboratory conditions. Scale-up trials were conducted using industrial batches with and without the additive, followed by wet milling, spray drying, pressing, and firing, with each processing stage analyzed. Compaction pressure varied between 300–330 kg/cm² for 330×330 mm tiles, with thickness ranging from 7.0 to 8.1 mm. Instrumental analysis tracked mineralogical transformations and gas evolution during firing. Standard compositions contained quartz, mullite, and gehlenite, while tiles with the additive formed berlinite. Results confirm CERADIT+'s suitability for floor tile production, meeting industrial specifications. Future research will refine additive quantities for broader ceramic applications.

Acknowledgments This investigation is supported by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia (Contract No. 451-03-136/2025-03/200012).

P40

Assessment of the Compositional and Radiological properties of Raw Clay and Shale Blends used in Ceramic Brick manufacturing

Milica Vidak Vasić[1], Predrag Kuzmanović[2,3], Jan Hansman[2], Pedro Muñoz Velasco[4]

[1]Institute for Testing of Materials IMS, Bulevar vojvode Mišića 43, 11000 Belgrade, Serbia
[2]University of Novi Sad, Faculty of Sciences, Department of Physics, Novi Sad, Trg Dositeja Obradovića 4, 21000 Novi Sad, Serbia
[3]Academy of Applied Studies Šabac, Department of Medical and Business-Technological Studies, Hajduk Veljkova 10, 15000 Šabac, Serbia
[4]ESIT, Universidad Internacional de La Rioja, Avda. de la Paz 137, 26007 Logroño, Spain

The use of shale ore in ceramic brick manufacturing offers numerous advantages, including the possibility of improved strength and thermal stability. Moreover, the environmental impact associated with mining can be minimized by partially replacing raw clay with other alternatives such as shale. The feldspars and other minerals in shale affect the raw brick mixture's workability and plasticity. Therefore, this study examined the mechanical, thermal, and radioactive properties of raw clay and shale mixtures to assess their suitability for ceramic brick production. Key parameters like shrinkage, loss on ignition, compressive strength, and water absorption are specifically examined to determine the effects of adding 10 % and 20 % shale by weight to the factory raw clay mixture. The concentrations of natural (^{238}U, ^{235}U, ^{226}Ra, ^{232}Th, ^{40}K) and artificial (^{137}Cs) radionuclides were measured before and after the firing process to determine the radioactivity of raw clay, shale, and the resulting burnt bricks. Hazard indices and annual effective dose estimations for consumers and industrial personnel were used to assess the radiological dangers related to these products. A comparison of the results of this study with those of related research and regulatory criteria was done to ascertain the safety of the bricks when used for construction. This study provides useful details on potential radiological hazards and the safe use of Serbian shale in ceramic brick production, and suggestions for enhancing the security and usability of building materials.

Acknowledgments: This investigation is supported by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia (Contracts No. 451-03-136/2025-03/200012, 451-03-137/2025-03/200125 and 451-03-136/2025-03/200125).

P41

The effect of Na_2WO_4 on the Briggs-Rauscher oscillatory reaction: catalytic activity research

Jelena Maksimović[1], Kristina Stevanović[2], Zoran Nedić[1], Pavle Tančić[3], Jelena Senćanski[4], Stevan Blagojević[4], Maja Pagnacco[3]

[1]Faculty for Physical Chemistry, University of Belgrade, Studentski trg 12-16, 11000, Belgrade, Serbia
[2]University of Belgrade, Vinča Institute of Nuclear Sciences-National Institute of the Republic of Serbia, University of Belgrade, Mike Petrovića Alasa 12-14, 11351 Vinča, Belgrade, Serbia.
[3]University of Belgrade, Institute of Chemistry, Technology and Metallurgy, Department of Catalysis and Chemical Engineering, Njegoševa 12, Beograde, Serbia
[4]University of Belgrade, Institute of General and Physical Chemistry,
Studentski trg 12-15, 11000 Belgrade, Serbia

The Briggs-Rauscher (BR) is a well-known chemical oscillatory system. It is interesting because the oscillatory dynamics occur at room temperature and its sensitivity towards different perturbators. Our previous work was related to the testing of insoluble materials, such as phosphate tungsten bronzes. In this work, the addition of different concentrations of sodium tungstate Na_2WO_4 in the BR reaction is investigated. The Na_2WO_4 has multifaced application. It acts as a fluxing agent in the glass and ceramics industry. Sodium tungstate significantly influences the oscillatory dynamics. The effect of Na_2WO_4 is more pronounced on the length of the BR oscillation time, then on the amplitude of oscillations. This behavior could be related to the catalytic influence of tungsten ion on hydrogen-peroxide decomposition reaction via metal peroxo complex catalysis.

P42

PVDF/ZnO nanocomposite applications in the development of piezoelectric MEMS sensors: Theoretical Considerations

Adriana Peleš Tadić[1], Ivana Jokić[2], Darko Kosanović[1]. Jelena Živojinović[1],
Nenad Tadić[3], Nina Obradović[1]

[1]Institute of Technical Sciences, Serbian Academy of Sciences and Arts, Belgrade, Serbia
[2]University of Belgrade - Institute of Chemistry, Technology and Metallurgy - National Institute of the Republic of Serbia, Njegoševa 12, 11000 Beograd
[3]University of Belgrade, Faculty of Physics, Studentski trg 12 11001 Belgrade, Serbia

Poly(vinylidene fluoride) (PVDF) is a semi-crystalline polymer known for its excellent pyroelectric and piezoelectric properties. While its dielectric permittivity is lower than that of piezoelectric ceramics, PVDF offers notable advantages for sensing applications, such as low density, mechanical flexibility, and toughness. These characteristics have made PVDF a popular choice in MEMS technology, as well as in ultrasound transducers and medical ultrasound systems. PVDF can crystallize into five different phases — α, β, γ, δ, and ε. Among these, the β-phase is the most desirable for MEMS applications due to its superior electroactive properties.

The analysis of PVDF and PVDF-based nanocomposites with ZnO as a filler has shown that the proportion of the beta phase increases with the addition of mechanically activated ZnO powder, thereby improving the piezoelectric properties of the material. These materials could therefore find applications in the development of piezoelectric MEMS sensors. Among them are highly sensitive chemical and biological thin film bulk acoustic wave resonant (FBAR) sensors. In this paper we presented the results of the theoretical analysis of sensor noise, which arises from the stochastic nature of the physical processes underlying the operation of adsorption sensors. Such analysis is important since it enables the estimation of sensors' limiting performance, and provides the guidelines for the optimization of sensor design during the development process.

P43

Determination of Painting Technology of 18th Century Icon Paintings from Orthodox Monasteries

Marija Kovač[1], Dragana Jelić[2], Vesna Miljić[1], Bojan Miljević[1], Olivera Brdarić[2],
Snežana Vučetić[1]

[1]University of Novi Sad – Faculty of Technology, Laboratory for Materials in Cultural Heritage (HERITAGELAB), Bulevar cara Lazara 1, 21000, Novi Sad, Serbia
[2]The Provincial Institute for the Protection of Cultural Monuments, Petrovaradin, Štrosmajerova 22, 21131 Petrovaradin, Republic of Serbia

The determination of painting technology in historical Icons is an essential step in understanding artistic practices, material and technological changes across different historical periods. Additionally, the presence of degradation products, as well as used pigments and binders, has a significant role in conservation decisions and the preservation of cultural heritage. To obtain insight

into the painting technology of 18th century Icon paintings from Orthodox monasteries was the main focus of this research, which combined in situ diagnostic and laboratory-based analyses of micro-samples from different Icon paintings from 18th century. Information about the surface morphology, stratigraphic insights, and the chemical composition of the used painting materials, as well as the presence of deterioration were obtained. Non-destructive in situ analyses (digital microscopy, XRF, DRIFT FTIR analysis) were used for preliminary examination. Samples were taken based on the obtained results and the condition of the Icon paintings. For laboratory examination, optical microscopy with polarized light, XRF, and ATR FTIR analyses were used. An integrated approach of in situ and laboratory examination ensured minimal intervention on the original surfaces and provided detailed information about the painting technology, materials, and techniques used, directly contributing to the broadening of knowledge about 18th century practices in Orthodox Icon painting. The obtained results were successfully used in further conservation decisions throughout the restoration processes.

Acknowledgement: The authors would like to acknowledge the support from Ministry of Science, Technological Development and Innovations (Republic of Serbia), project No. 451-03-136/2025-03/200134 and 451-03-137/2025-03/200134.

P44

From biowaste to active ingredients for biocosmetic production

Miljana Mirković, Ana Kalijadis

Department of Materials, “Vinča“ Institute of Nuclear Sciences-National Institute of the Republic of Serbia, University of Belgrade, Belgrade, Serbia

In modern life, coffee is one of the most commonly used raw materials for beverages. Over the past decade, the trend of home consumption has expanded beyond traditional types of coffee to include espresso and filter coffee. This shift has resulted in the generation of solid coffee residue, which can be repurposed for other uses. Unfortunately, the disposal or composting of this waste is not well-regulated, and the valuable remains from coffee preparation often end up as municipal waste. The goal of this work is to reuse the solid residue from espresso coffee preparation through the pyrolysis process to obtain carbon materials that can be incorporated into cosmetic products. The carbon material obtained through pyrolysis exhibits exceptional physicochemical properties, making it a suitable component for cosmetic products with skin-cleansing effects, all while being environmentally friendly and non-toxic. The properties of the obtained carbon material were analyzed using methods such as XRD, FTIR, and BET. The resulting material was utilized in a cosmetic product as both an abrasive and adsorbent component in face cleansing milk. The results related to the production information certificate confirm that the obtained material is safe to use in cosmetic products.

Acknowledgments: Project “Innovation Concept “The potential of coffee in the cosmetics industry - from waste to active ingredients for the production of biocosmetics”, under the Public Call for the Improvement of Cooperation Between Science and Economy in the Field of Circular Innovations - CIRCULAR VOUCHERS 2024 with the technical and financial support of The United Nations Development Programme, European Union (Ref.: 00131890/1138320/2024/01-09).

P45

Thermal stability, crystallization kinetics, and structural characterization of FeGaAlPCB amorphous ribbons

Nebojša Mitrović[1], Mirjana Šiljegović[2], Goran Štrbac[2], Radoslav Surla[3],
Borivoje Nedeljković[1], Jovana Mandić[3]

[1]Joint Laboratory for Advanced Materials of SASA, Section for Amorphous Systems,
Faculty of Technical Sciences Čačak, University of Kragujevac, Serbia,
[2]Department of Physics, Faculty of Sciences, University of Novi Sad, Serbia
[3]Military Technical Institute, Belgrade, Serbia

Among amorphous ferromagnetic materials, researchers are focusing on Fe-based and Co-based alloys, as technological progress of soft magnetic materials is essentially to attain high performance of many advanced magnetic devices and their emerging applications (smart mobile phones, IoT smart society, biomagnetic field detection, etc).

Thermal stability and phase transformation of multicomponent soft magnetic alloys are essentially relevant for the development and functionality of the magnetic element and devices. Internal stresses arising during the production process of rapid melt quenching are the subject of post-processing studies that enable magnetic softness, especially in less expensive Fe-based alloys. The metastability of amorphous ribbons makes them prone to structural transformations that bring optimum electrical, magnetic, and mechanical properties suitable for a specific application (magnetic sensors, magnetic valves, or clutches).

In the present work, FeGaAlPCB amorphous ribbons obtained by the rotating melt-spinning method were studied. Morphological and structural characterization was performed using Optical Microscopy (OM) and Scanning Electron Microscopy (SEM) with Energy Dispersive Spectroscopy (EDS). The microstructural morphology of the surface observed by OM reveals surface roughness that can affect the distribution and movement of magnetic domains, and thus the magnetic properties of ribbons. Elemental EDS microanalyses confirmed the presence of all constituent elements of the alloy. As-cast samples were examined by the non-isothermal DSC method and X-ray diffraction. The kinetics of the crystallization process observed at about 800 K were investigated by the Kissinger method and by the Arrhenius equation using DSC analysis at constant-rate heating from 10 K/min to 50 K/min.

Acknowledgements This research is supported in part by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia, and these results are part of Grant No. 451-03-137/2025-03/200132 with the University of Kragujevac - Faculty of Technical Sciences, Čačak.

P46

Sustainable Cement Design with Hybrid SCMs: Integrating Recycled Concrete, Eggshells and Calcined Clay

Nevenka Mijatović, Anja Terzić, Ana Kontić, Isidora Šušić, Milica Vasić,
Biljana Ilić, Ljiljana Miličić

Institute for Institute for Testing of Materials, Bulevar vojvode Mišića 43,
11000 Belgrade, Serbia

The cement industry faces urgent challenges in reducing carbon emissions while maintaining performance standards. This study explores the development of sustainable cementitious systems using hybrid supplementary cementitious materials (SCMs) derived from recycled concrete powder (RCP), thermally activated clay, and eggshell waste. These materials were selected based on their local availability, reactivity potential, and environmental value. Comprehensive characterization of the raw components was carried out using X-ray fluorescence (XRF) and inductively coupled plasma optical emission spectrometry (ICP-OES) to determine chemical composition, while Fourier-transform infrared spectroscopy (FTIR) was employed to identify functional mineral phases. Physical properties such as specific surface area, particle size distribution, and density were also measured. Cement mortars were prepared with 10–30% replacement of ordinary Portland cement by the hybrid SCM blend. Compressive strength was tested after 7, 28, and 90 days of curing. The mixture with 20% SCM substitution exhibited the best performance, achieving up to 18% higher compressive strength than the reference mix. The synergy of RCP, eggshells, and calcined clay provided enhanced reactivity and microstructural refinement. The results confirm that combining recycled and biogenic waste streams offers a promising route toward eco-efficient cement design, aligning with global goals for circular construction and carbon footprint reduction.

Acknowledgements: This investigation is supported by The Ministry of Science, Technological Development and Innovation (contract number: 451-03-136/2025-03/ 200012).

P47

Effect of higher CO_2 content on physical and mechanical properties of aerial lime mortars for conservation purposes

Ana Kontić, Nevenka Mijatović, Isidora Šušić, Biljana Ilić, Anja Terzić, Ljiljana Miličić

Institute for Materials Testing, Bulevar vojvode Mišića 43, 11000 Belgrade, Serbia

Until the end of the 18th century, lime-based mortars were considered as an element of continuity in built heritage. Repercussions of using incompatible materials in restoration practice were reflected in the development of requirements for using repair mortars that are compatible with the original materials, as lime mortar is. Even though this topic has been extensively investigated from both structural and material point of view, use of lime mortars in restoration works is yet scarce.

This study investigates the influence of increased CO_2 content on physical and mechanical properties of aerial lime mortars. As lime mortar is a material that uses CO_2 for its hardening process, this consumption is beneficial for environment and material quality as well. After 7 days of curing, samples were placed in accelerated carbonation chamber, with high CO_2 content (5%). The results were compared with a reference mortar, cured in standard condition and tested after 180 days. Results show that full carbonation was achieved in accelerated carbonation conditions, verified by both TGA and phenolphthalein test. In reference samples, 8% of still uncarbonated lime was observed after 180 days. These results were in accordance with results of open porosity, showing lower values of samples under higher CO_2 conditions. UPV results, used as a tool for accessing anisotropy showed lower values of anisotropy in accelerated carbonation conditions, meaning that higher level on homogeneity in these samples was achieved. Regarding mechanical strengths, flexural strength was 57% higher for accelerated carbonation conditions, when compared with 180-days old reference sample. In the case of compressive strength, this difference was around 32%.This study suggests that trapping CO_2 into the structure of aerial lime mortar, have positive effect its hardened properties, making it adequate for its use in conservation practice. Therefore, it opens up new questions regarding filed application of these findings.

Acknowledgements: This investigation is supported by The Ministry of Science, Technological Development and Innovation (contract number: 451-03-136/2025-03/200012)

P48

Ancient Ceramics Techniques and The Role of AI in Integrating STE(A)M Approaches

V. B. Pavlović[1], B.Novaković[2], V.P. Pavlović[3]

[1]University of Belgrade, Faculty of Agriculture, Belgrade, Serbia
[2]University of Milano-Bicocca, Italy
[3]University of Belgrade, Faculty of Mechanical Engineering, Belgrade, Serbia

Ancient ceramics represent one of humanity's earliest and most enduring technological achievements, with techniques refined over millennia through empirical experimentation. These methods hold untapped potential for advanced materials research, particularly in sustainable manufacturing, microstructure engineering, and adaptive design. Simultaneously, AI is emerging as a transformative tool for interpreting historical craftsmanship and integrating it into modern STE(A)M frameworks. The objectives of our work are to examine how ancient ceramics techniques can inspire contemporary research and how AI can facilitate this interdisciplinary exchange and be used in STE(A)M education. This study examines ancient ceramic techniques to extract relevant scientific principles, explores AI's role in decoding archaeological knowledge for materials science, and develops AI-integrated STE(A)M education models. We conclude that ancient ceramic techniques provide an exemplary model of pre-modern STE(A)M integration, offering valuable insights for contemporary interdisciplinary education and a deeper appreciation of historical technological sophistication. By deconstructing the processes of material selection, forming, decoration, and firing, we uncover the inherent science, technology, engineering, art, and mathematics embedded within these ancient practices. The study concludes that the synergy between ancient ceramics and AI not only advances materials research but also fosters interdisciplinary innovation, preserving traditional knowledge while driving future technological developments.

Exhibition
Leaking Machine

Dr.A. Valentina Savić

Leaking Machine is a work that aims to connect science and art. It consists of two sets of works (Junkspace and Laboratory Exercises of Flow) created during doctoral-artistic research on the topic of *Contemporary Vinča - the potential of conceptual ceramic practices* at the Faculty of Applied Arts in Belgrade.

The works are inspired by the technology of making ceramics of the Vinča civilization and the first recorded creation of a composite material.

The *Junkspace* triptych examines the boundary between organic and inorganic, permanent and disposable. It conceptually connects the specific cultural stratigraphy of the Vinča settlement where: the Vinča landfill, the Vinča Nuclear Institute and the Neolithic site of Belo Brdo coexist. With the form of a vessel that simultaneously alludes to an amphora, a rocket and a filter, the work re-examines the registers of the civilizational imprint and proposes industrial waste as a potential resource. Three contemporary combustible materials were chosen for the production, which come from the “medium” of waste (feminine pads, toilet paper and disposable masks), and it is possible to transform them into a kind of new inorganic fossil through “porcelainization”.

The Laboratory Exercises of Flow explore the types of ceramic composites. The clay is mixed with natural organic materials, textiles, paper and industrial materials. The microstructures that are formed by this mixture after firing can have a practical purpose, and this work in one of its segments also points to possible directions of future scientific and artistic research.