



# ***Book of Abstracts***

***8th International Materials Science Conference***  
***HighMatTech-2023***

*October 2-6, 2023*  
*Kyiv, Ukraine*



# Contents

<b>CERAMICS AND GLASSES . . . . .</b>	<b>1</b>
Controllable synthesis of doped ceria nanopowders by cations with different valence state	
<i>Branko Matovic . . . . .</i>	<b>2</b>
Prospects for the Application of Bulk Materials and Vacuum-Arc Deposited Coatings Based on Ti,Nb-Al-C MAX phases Demonstrating High-temperature Wear Resistance, High Electrical Conductivity and Stability in Oxygen and Hydrogen Environments.	
<i>Tetiana Prikhna, Jrest Ostash, Alexander Kuprin, Viktoria Podhurska, Tetiana Serbenyuk, Volodymyr Sverdun, Bernd Büchner, Julia Hufenbach, Semyon Ponomaryov, Myroslav Karpets, Anatoly Marchenko . . . . .</i>	<b>3</b>
The effect of ZrO <sub>2</sub> concentration on the optical properties of Y <sub>2</sub> O <sub>3</sub> transparent ceramics	
<i>Dariia Chernomorets, Jan Hostaša, Laura Esposito . . . . .</i>	<b>5</b>
Infrared transparent ceramics of complex architecture for extreme operating conditions	
<i>Roman Yavetskiy, Olexandra Kryzhanovska, Nadiia Safronova, Dariia Chernomorets, Oxana Matvienko, Serhii Parkhomenko, Andrii Doroshenko, Ihor Vorona, Anton Balabanov, Arsenii Timoshenko . . . . .</i>	<b>6</b>
AlMgB14-related orthorhombic boron carbide phases from first principles: structure and mechanical properties	
<i>Oleksiy Bystrenko, Jingxian Zhang, Dong Fangdong, Xiaoguang Li, Weiyu Tang, Kaiqing Zhang, Jianjun Liu . . . . .</i>	<b>7</b>
Effect of Mn doping on structural and optical properties of (Zn,Mg)O ceramics	
<i>Iryna Markevich, Tetyana Stara, Yuliia Polishchuk, Semyon Ponomaryov, Kostiantin Kozoriz, Oleksandr Melnichuk, Lyudmyla Melnichuk, Nadiia Korsunska, Lyudmyla Borkovska, Larysa Khomenkova . . . . .</i>	<b>8</b>
Structure, mechanical characteristics and high temperature stability of sintered under high and by hot pressing ZrB <sub>2</sub> - and HfB <sub>2</sub> - based materials without and with SiC and Si <sub>3</sub> N <sub>4</sub> additions	
<i>Tetiana Prikhna, Anastasiya Lokatkina, Pavlo Barvitskyi, Myroslav Karpets, Viktor Moshchil, Semyon Ponomarov, Jochen Werner, Bernd Büchner, Richard Haber, Zeynep Ayguzer Yasar, Branko Matovich, Robert Kluge, Anatoly Bondar, Alexander Borymskyi, Leonid Devin . . . . .</i>	<b>9</b>

Phase transformations during heat treatment of germanium-doped hydroxyapatite and their influence on physico-chemical and biological properties <i>Nataliia Ulianchych, Sergey Firstov, Volodymyr Kolomiiets', Oksana Koriak, Larysa Strilets, Mykhailo Rublenko, Tetiana Todosiuk</i>	11
Machine Learning assisted structure optimization and mechanical properties assessment of Si-doped boron carbide <i>Oleksandr Vasiliev, Vladyslav Bilyi, Valerii Bekenov, Valerii Kartuzov</i>	12
Influence of Lead Oxide Addition on the Electrical Characteristics of Tin Oxide Based Ceramic Varistors <i>Alexei Gaponov</i>	13
Synthesis of alkaline nitride glasses and their physical and chemical properties <i>Eugen Pashchenko, Denys Savchenko, Svitlana Kukharenko, Sergiy Skorokhod, Roman Kurganov</i>	14
Study of silicon carbide and silicon nitride ceramics by the method of acoustic emission <i>Victor Goncharuk, Irina Goncharova, Vadim Tsyvilitzin, Mykola Iefimov</i>	15
Mechanical and dielectric properties of ceramics based on Si <sub>3</sub> N <sub>4</sub> produced by spark plasma sintering <i>Maryna Zamula, Valerii Kolesnichenko, Nadiya Tyschenko, Oleksandr Shyrokov, Artur Stepanenko, Hanna Borodianska, Andriy Ragulya</i>	16
3D printing of the ceramic materials based on Mo <sub>0.9</sub> Cr <sub>0.1</sub> Si <sub>2</sub> by Robocasting technique <i>Vladyslav Naumenko, Ostap Zgalat-Lozynskyy, Dmytro Zyatkevych</i>	17
Scale particles from rocks - fillers for polymer composite materials <i>Iryna Diduk, Olga Jashchenko, Kateryna Krasnikova</i>	18
Glass and fibers based on silicate-hafnium and silicate-boron-hafnium systems <i>Iryna Diduk, Yurii Chuvashov, Olga Jashchenko, Nataliya Koshelenko</i>	19
The influence of aluminum oxide on the physical and mechanical properties of silicate fibers <i>Yurii Chuvashov, Olga Yashchenko, Iryna Diduk, Nataliya Koshelenko</i>	20
Preparation of Ti <sub>3</sub> SiC <sub>2</sub> MAX phases using high-energy ball milling of the initial components in a planetary mill <i>Maria Savyak, Dmytro Korablov, Alla Kopan, Yuriy Solonin</i>	21
Phase diagram of the Fe <sub>7</sub> Se <sub>8</sub> -Bi <sub>2</sub> Se <sub>3</sub> system <i>Serhii Lakiza, Kingshuk Bandopadhyay, Krzysztof Markus, Yaroslav Korol</i>	22
Increased wear resistance of end seal rings due to the use of improved ceramic material based on silicon carbide <i>Ihor Hnylytsia</i>	23
On the methodology of generalization of knowledge about the structure formation of ceramic materials to implement it in technology <i>Galyna Oleynik, Andrii Kotko</i>	24

Structure formation of ultradispersed detonation diamond <i>Galyna Oleynik, Andrii Kotko, Yurii Solonin</i> . . . . .	25
Influence of lead oxide addition on the electrical characteristics of tin oxide based ceramic varistors <i>Alexei Gaponov</i> . . . . .	26
Structural and mechanical properties of SiC-rich by-products of the metal grade Si (MG-Si) process <i>Vira Bovda, Thomas Hafner, Joans Hafner, Frank Kimm, Oleksandr Bovda, Oleksandr Kuprin, Anatoliy Pikalov, Viktoria Podhurska, Bohdan Vasyliv, Ihor Vorona</i> . . . . .	27
Ground states in B4C-Al system <i>Oleksandr Vasiliev, Vladyslav Bilyi, Yaroslav Zaulychnyy, Valerii Kartuzov</i> . . . . .	28
<b>COMPOSITE MATERIALS</b> . . . . .	29
Ceramic composites reinforced with high-entropy borides for high-temperature applications <i>I. Bogomol, E. Ferkhatly, Duan Mantang, D. Reznik, S. Ponomarchuk, P. Loboda</i> . . . . .	30
Sustainable composites <i>Petre Badica</i> . . . . .	31
Utilization of Sr <sub>2</sub> Ni <sub>2</sub> O <sub>5</sub> /rGO composites as electrode material in supercapacitor. <i>Farooq Ahmad</i> . . . . .	32
Effects of thermo-hardening and thermo-plastification at 200-280 °C for micro-filled epoxy-composites. Examples for filling by silicon carbide, titanium nitride, gypsum G5 and Cement M400. <i>Dmitro Starokadomsky, Mariia Reshetnyk</i> . . . . .	33
Features and theoretical analysis electric and thermoelectric properties of Co/Al <sub>2</sub> O <sub>3</sub> , Co/SiO <sub>2</sub> and Co/TiO <sub>2</sub> ferromagnetic nanocomposites in the low-temperature region <i>Oleksii Baibara, Mykhailo Radchenko, Arsenii Ievtushenko, Yaroslav Stelmakh, Larysa Krushynska, Tatiana Zajarniuk, Tomashz Story</i> . . . . .	34
Effect of crystallization properties of continuous basalt fibers on thermal stability of composite materials <i>Stanislav Ivanitskii, Yurii Chuvashov</i> . . . . .	35
Cyclic Heat Resistance and Peculiarities of Oxidation of Nickel Reactive Sintered Alloys <i>Viktor Solntsev, Gennady Bagluk, Tetiana Solntseva, Kostiantyn Petrash, Alevtina Mamonova, Galina Molchanovsky</i> . . . . .	36
Advanced Nanocomposites TiO <sub>2</sub> -Ag for Viruses Remediation <i>Maksym Zahornyi, Olena Lavrynenko, Nadya Tyschenko, Andrey Ragulya, Olga Povnitsa, Liubov Artiukh, Svitlana Zahorodnia, Arsenii Ievtushenko</i> . . . . .	37
Nanostructured materials compacted via hot pressing method by direct current transmission <i>Edwin Gevorkyan, Oksana Morozova, Chyshkala Volodymyr, Volodymyr Nerubatskyia</i> . . . . .	38

## **Nanostructured materials compacted via hot pressing method by direct current transmission**

Edwin Gevorkyan<sup>1</sup>, Oksana Morozova<sup>1</sup>, Chyshkala Volodymyr<sup>2</sup>, Volodymyr Nerubatskyi<sup>1</sup>  
oksanabakan2012@gmail.com

<sup>1</sup>*Ukrainian State University of Railway Transport, Ukraine*

<sup>2</sup>*V. N. Karazin Kharkiv National University, Ukraine*

Nanostructured ceramics have unique properties and performance characteristics due to the formation of a fundamentally different structure compared to their large-crystal counterparts. The most important stage in the technology of nanoceramics production is the formation of quality pressings (compacts) of a given shape made of ceramic nanopowders. NPs of ceramic compositions (often very complex) have a metastable structural-phase state, a developed specific surface and as a consequence, high surface activity and tendency to agglomerate. Pre-prepared tungsten carbide tablets were hot-pressed in a vacuum of 10-2 mmHg. Maximum pressure for graphite PG-7 is about 50 MPa at a temperature higher than 1200°C, so the maximum force for the given mould with a punch d=20 mm is 45 MPa. Temperature of termination of shrinkage has made 1700°C. The density of pressings after grinding was determined by hydrostatic weighing. Rockwell HRA hardness was determined by indenting a diamond pyramid on the TM-12. During high-temperature sintering under load the WC grain size increased insignificantly, remaining mostly less than 1 μm. At the same time there is practically no porosity in the materials. That is why high values of  $\sigma_{vizr} = 720$  MPa were obtained. In our case, a high value of fracture toughness K1c, which is important for cutting tool ceramics, can also be expected with a high value of HRA. The increase of fracture toughness of such material can be explained on the basis of the known model of increase of K1c in polycrystalline materials, namely by the joint action of two factors: highly dispersed grains and low strength boundaries both between grains below 1 μm and between coarser ones. To conclude, the method of hot pressing under direct current flow makes it possible to obtain high-density nanoporous tungsten carbide products with high physical and mechanical properties.

### **Acknowledgments**

The state budget topic The Use of Non-traditional Methods of Obtaining Nanopowders and Sintering in the Development of Modified Mullite-ZrO<sub>2</sub> Ceramics Resistant to Heat Shock (State Registration Number 0121U109441).