The Serbian Society for Ceramic Materials

Institute for Multidisciplinary Research (IMSI), University of Belgrade

Institute of Physics, University of Belgrade

Center of Excellence for the Synthesis, Processing and Characterization of Materials for use in Extreme Conditions “CEXTREME LAB” - Institute of Nuclear Sciences “Vinča”, University of Belgrade

Faculty of Mechanical Engineering, University of Belgrade

Center of Excellence for Green Technologies, Institute for Multidisciplinary Research, University of Belgrade

Faculty of Technology and Metallurgy, University of Belgrade

PROGRAMME and the BOOK of ABSTRACTS

7CSCS-2023

7th Conference of the Serbian Society for Ceramic Materials
June 14-16. 2023. Belgrade Serbia

Edited by:
Branko Matović
Jelena Maletaškić
Vladimir V. Srdić

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SYNTHESIS AND CHARACTERIZATION OF REINFORCED ALUMINA COMPOSITES

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Alumina composite was prepared via simple route. Alumina ceramics that resembels seashells are made of aligned micron-sized monocrystalline platelets joined together by silica secondary phase. SiO_2 was added to improve mechanical properties of composite. The evolution of the phase composition during thermal treatment was investigated by X-ray powder diffraction (XRPD) and thermal analyses. Effect of sintering temperature on mechanical properties, due to the increase of sintering temperature that can produce a higher strength and higher density, was also investigated. SEM observation of composite was also included. Ceramics composites such as this are good candidates for high temperature oxidation atmosphere applications, as they have excellent mechanical and other performance requirements.

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ALUMINUM-BASED COMPOSITES REINFORCED WITH CERAMIC FIBERS

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The modern transportation industry is in high demand for lightweight structural components with exceptional mechanical properties that can be obtained by a cost-effective production process. These specific industrial requirements can be achieved through the attainment of innovative aluminum matrix composites (AMCs) with improved characteristics in accordance with the circular economy. Solid-state recycling is considered a good solution to attain the above-mentioned industrial

demands since it enables the obtainment of usable and inexpensive raw materials with known chemical composition from industrial waste and therefore supports the cost-effective production of structural components. The present research was, therefore, directed toward the repurposing of waste materials derived from the metal industry and the civil engineering sector through a simple and economical solid-state recycling procedure to obtain raw materials for the production of innovative AMCs with required characteristics. The aluminum 2xxx series alloy, *i.e.* 2024 alloy, in the form of metallic chips generated during the industrial machining was selected for the obtainment of composite base, while basalt fibers derived from stone mineral wool, as waste material in civil engineering, were used to produce the composite reinforcing phase. Basalt, characterized by high strength and low density, provides improved resistance to chemical and mechanical damage, while the 2024 alloy contributes to good fatigue properties of the final fiber-reinforced AMCs. To obtain usable raw materials for the AMCs preparation from the solid industrial waste the basalt fibers were thermally treated, while aluminum-based metallic chips were ball-milled. Treated aluminum alloy powder and basalt fibers were mixed in a 3D tumbler mixer in a 9:1 ratio, isostatically pressed, and sintered in a protective argon atmosphere at 550 °C. Isostatic pressure and sintering duration were varied during the AMCs preparation to determine the optimal processing parameters for the obtainment of AMCs with the required characteristics for a predetermined purpose. The scanning electron microscopic (SEM), energy dispersive spectroscopic (EDS), and X-ray diffraction (XRD) analyses complemented with hardness and density measurements were conducted to characterize starting and final materials. Obtained composites showed improved mechanical properties compared to the starting aluminum alloy, regardless of the processing conditions. The AMCs processed at a higher pressure and for longer sintering times showed higher density and hardness. The results of the presented research undoubtedly indicated that solid-state recycling, as a simple, energy- and cost-efficient process, can be successfully used for the attainment of innovative composites for lightweight structural components in the transportation industry.

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