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

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Branko Matović
Jelena Maletaškić
Vladimir V. Srdić

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SPECIAL THANKS TO

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ТЕХНОЛОШКОГ РАЗВОЈА И ИНОВАЦИЈА

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where *S* is the Seebeck coefficient, σ is the electrical conductivity and κ is the thermal conductivity. Therefore, materials with high σ and *S* combined with a low κ will make a positive effect on TEG performance. For high-temperature applications the state-of-the-art metal-based thermoelectric devices are ruled out due to oxidation and melting. Because of their stability at elevated temperatures, oxides become a favorable choice. The efficiencies of oxides and oxide-based TEGs are still insufficient for commercial purpose and development of oxides with improved thermoelectric properties is demanded.

In this review, some of the state-of-the-art of oxide-based thermoelectric materials and devices will be highlighted, followed by a discussion on the challenges and advantages of oxide-based TEGs. Our recent results related to improved material properties and a promising novel design of all-oxide TEGs for operation at high temperatures in ambient atmosphere will be presented too [1–3].

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I-30

THERMOELECTRIC Cu DOPED SODIUM COBALTITE – STRUCTURAL, MAGNETIC AND MECHANICAL PROPERTIES

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With the increase of the consumption of electrical energy, the need for new energy sources is growing. Conversion of waste heat into electricity, based on the thermoelectric effects is one of the ways to produce the electrical energy. Layered cobalt oxides have been the subject of many investigations in past decade as candidates for application in energy conversion. The ceramic sodium cobaltite became a promising candidate for potential thermoelectric applications, because of its large thermopower and low resistivity. In this work, polycrystalline samples of $NaCo_{2-x}Cu_xO_4$ (x = 0, 0.01, 0.03, 0.05) were synthesized from the powder precursors obtained by the citric acid complex method (CAC) and mechanochemically assisted solid state reaction method (MASSR). The obtained powders were uniaxially pressed into disc-shaped pellets and subsequently sintered at 880 °C in inert argon atmosphere. Thermoelectric parameters (the electrical resistivity (ρ), the thermal conductivity (κ) and the Seebeck coefficient (S)) were measured in two temperature regions. In the first one (between 2 and 300 K) κ and S were measured by a Quantum Design physical property measurement system (PPMS 9T) equipped with a 9 T magnet and ρ by a standard four-terminal technique using the direct current. In the second, all parameters were measured simultaneously, in the temperature gradient (ΔT) between hot and cold sides of the samples using Z-meter, based on the "large ΔT method", and the figure of merit (ZT) was subsequently calculated. Accordingly, ρ, κ and S were determined for a temperature gradient that is established between the hot and cold sides of the samples at the time of each measurement; thus the obtained values represented the actual thermoelectric response of a material under conditions of application. In the low temperature range the highest figure of merit of 0.022 at 300 K was observed for the CAC sample doped with 1 mol% Cu, and it was almost twice higher than in the undoped sample confirming the significant influence of Cu-doping with even small concentrations. As for the results obtained in the temperature gradient, the highest ZT value of 0.061 at ΔT = 473 K was observed for the sample with 5 mol% of Cu prepared by the CAC method. Sample magnetization was measured using a Quantum Design SQUID MPMS-XL-5 magnetometer in zero field cooled (ZFC) and field cooled (FC) regimes, between 2 K and 300 K and in the applied field of 100 Oe. The magnetic susceptibility (χ) of all samples followed the Curie-Weiss law in the temperature range between 50 K and 300 K, while a negative Weiss constant (θ) implied an antiferromagnetic interaction. Indentation experiments were carried out to investigate mechanical properties, therefore, the hardness (H) and the Young's modulus of elasticity (Y) were determined using Agilent Nanoindenter G200. It was found that the highest Y (65.2 GPa) and H (1.41 GPa) were obtained for the CAC sample containing 1 mol% of Cu. These results indicated a significant improvement of mechanical properties even in the case of the sample with the lowest dopant concentration. In general, better thermoelectric and mechanic properties showed the samples synthesized by the CAC method, confirming that fine, homogeneous precursor powders present a good base for obtaining material with improved thermoelectric performances.