

The effect of Ga³⁺ and Cu²⁺ co-doping on ionic conductivity of Ceria Ceramics as Solid Electrolyte for IT-SOFCs

Monika Singh

Indian Institute of Technology -BHU, India

Abstract

The current investigation draw an attention to the effect of Ga³⁺ and Cu²⁺ addition on the structure, surface morphology and oxygen-ionic conductivity of ceria ceramics in the composition Ce_{0.8}Ga_{0.2-x}Cu_xO_{2-δ} for the promising candidate as the solid electrolyte material in the solid oxide fuel cells working in intermediate temperature range (IT-SOFCs). Ultrafine Ce_{0.8}Ga_{0.2-x}Cu_xO_{2-δ} (for 0 ≤ x ≤ 0.2) nanoceramics were prepared via glycine nitrate auto-combustion method. Phase identification, microstructure, and ionic conductivity of all the ceria ceramics were observed by powder XRD, SEM, TEM, and impedance analyses measurement were used to analyze phase identification, microstructure, and ionic conductivity of all the ceria ceramics respectively. Similar to cerium oxide cubic fluorite type structure having Fm-3m space group was confirmed by powder XRD followed by Rietveld structural analysis for all the co-doped systems. The density of all samples was found above 85% after sintering at 1300°C for 4 hrs. The presence of oxygen vacancies in all the compositions were revealed by Raman spectra. Thermal analysis for change in weight was carried out by TGA. Thermal expansion coefficient of the developed electrolytes matches with the commonly used electrode materials. The optimum composition Ce_{0.8}Ga_{0.05}Cu_{0.15}O_{1.825} was found to reveal the maximum ionic conductivity with least activation energy among all the existing co-doped ceria ceramics. These characteristics compose it a potential applications in the IT-SOFC as the electrolyte material.



Biography:

Monika Singh is 5th year Ph.D. student in School of Materials science and technology, Indian Institute of Technology, Banaras Hindu University (IIT-BHU) She is pursuing her research work under the supervision of Dr. Akhilesh Kumar Singh (Associate professor). She received his MSc in Physics from the Banaras Hindu University. She has expertise in the study of flash sintering behaviors and its applications. She has published

research papers in the international reputed journals and international conference proceedings.



Speaker Publications:

1. Uday Pratap Azad, Monika Singh, Sourav Ghosh, Ashish Kumar Singh, Vellaichamy Ganesan, Akhilesh Kumar Singh, Rajiv Prakash. "Facile synthesis of BSCF perovskite oxide as an efficient bifunctional oxygen electrocatalyst". International Journal of Hydrogen Energy 43(45) DOI: 10.1016/j.ijhydene.2018.09.134
2. Monika Singh, Akhilesh Kumar Singh "Studies on structural, morphological, and electrical properties of Ga³⁺ and Cu²⁺ co-doped ceria ceramics as solid electrolyte for IT-SOFCs". International Journal of Hydrogen Energy DOI: 10.1016/j.ijhydene.2019.09.084
3. Monika Singh, Dinesh Kumar, Akhilesh Kumar Singh, "Synthesis and structural study of cerium substituted La_{0.4}Ca_{0.6}MnO₃ solid oxide fuel cell electrode material", AIP conference proceedings.
4. Dinesh Kumar, Monika Singh, Akhilesh Kumar Singh, "Crystallite size effect on lattice strain and crystal structure of Ba_{0.25}Sr_{0.75}MnO₃ layered perovskite mangnite", AIP conference proceedings.
5. Vinita, Madhu Tiwari, Neha Agnihotri, Monika Singh, Akhilesh Kumar Singh, and Rajiv Prakash "Nanonetwork of Coordination Polymer AHMT-Ag for the Effective and Broad Spectrum Detection of 6-Mercaptopurine in Urine and Blood Serum" ACS Omega DOI: 10.1021/acsomega.9b01122

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