MgO-Doped CaO-Stabilized Zirconia: A Promising Earth-Abundant Electrolyte for Next-Generation Solid Oxide Cells

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The advancement of solid oxide cells (SOCs) for clean energy applications relies heavily on the development of high-performance, durable, and sustainable electrolyte materials. While yttria-stabilized zirconia (YSZ) is the conventional choice, the supply risk and cost associated with yttrium necessitate the exploration of alternative compositions based on more abundant elements.

In this study, we systematically investigate the potential of a sustainable electrolyte system by synthesizing CaO-stabilized zirconia (CSZ) co-doped with varying concentrations of MgO (1, 2, 3, and 4 mol%). The primary objective was to enhance the ionic conductivity and thermochemical stability required for SOC operating conditions while eliminating the dependence on critical raw materials. The electrolyte powders were synthesized and subsequently characterized through a comprehensive suite of techniques. X-ray diffraction (XRD) was employed to analyze the crystal structure and phase purity, while scanning electron microscopy (SEM) was used to examine the microstructural morphology of the sintered pellets. The crucial electrical properties were determined via electrochemical impedance spectroscopy (EIS) to quantify the ionic conductivity. Finally, the practical viability of these materials as SOC electrolytes was validated by measuring the open circuit voltage (OCV) of fabricated cells.

Canan is an undergraduate student in Materials Science and Engineering at Gebze Technical University. She is currently working on electrolyte development for solid oxide fuel cells (SOFCs), specifically on MgO-doped CaO-stabilized zirconia systems, under the supervision of Assoc. Prof. Dr. Aligül Büyükaksoy. Her research focuses on enhancing ionic conductivity and reducing raw material supply risks in SOFC electrolytes.

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