Proton electrolyte $BaZr_{0.25}Ce_{0.25}Nd_{0.25}Zn_{0.25}O_{3-\delta}$ for application in solid-state fuel cells

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Clean energy technologies are vital for sustainable development due to their use of renewable resources and low environmental impact. Solid oxide fuel cells (SOFCs) offer a promising approach by converting chemical energy from fuels like hydrogen, small hydrocarbons, methanol, and ethanol into electricity. Comprised of ceramic electrolyte, anode, and cathode, SOFC research aims to optimize these components to reduce operating temperatures to around 600°C, improving efficiency and expanding practical applications.[1-3] The proton electrolyte $BaZr_{0.25}Ce_{0.25}Nd_{0.25}Zn_{0.25}O_3$-δ (BZCNZ) was synthesized by co-precipitation and sintered via heat treatment. Its physical, chemical, morphological, and thermal properties were studied. Thermogravimetric analysis curves (TGA) showed untreated BZCNZ lost 15% mass by 650°C and 5% by 1000°C, while heat-treated samples (up to 800°C) exhibited only a 5% mass loss by 1000°C, indicating enhanced thermal stability. X-ray difraction (XRD) reveal the formation close to a single phase at 1300°C. In this temperature, the electrolyte densified, with scanning electron microscopy images (SEM) confirming pore closure at this temperature, an essential property for electrolyte functionality. Energy dispersive X-ray analysis (EDS) confirmed the targeted stoichiometry for perovskite formation. Electrolyte conductivity was tested from 400 to 800°C, reaching 3.7×10^{-3} $S.cm^{-1}$ at 650°C. These values are comparable to commercial electrolytes like BZCY doped with Ni and Cu.[3] Results indicate strong potential for use in solid oxide fuel cells.

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