



Proton conductivity in stoichiometric and sub-stoichiometric yttrium doped SrCeO₃ ceramic electrolytes

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Abstract

The crystal structure and electrical properties of stoichiometric perovskite proton conductors SrCe_{1-x}Y_xO_{3-δ} (where $x = 0.025, 0.05, 0.075, 0.1, 0.15, \text{ and } 0.2$ and $\delta = x/2$) and substoichiometric Sr_{0.995}Ce_{0.95}Y_{0.05}O_{3-δ} have been investigated. The conductivities of the samples were measured as a function of the partial pressure of oxygen at 600 and 800 °C, and at two water vapor pressures ($P_{\text{H}_2\text{O}} = 0.01$ and 0.001 atm). A P_{O_2} range of 1 atm (pure O₂) to approximately 1×10^{-25} atm (N₂/H₂ mix) allowed for the separation of n-(electron), p-(hole), and i-(ionic) type conductivities.

In the case of stoichiometric perovskite proton conductors, the unit cell volume (UCV) and calculated density decrease with increasing yttrium content. The ionic and p-type components of the conductivity show threshold effect with Y-doping, which may be related to the double substitution of Y on both A- and B-sites. A maximum ionic conductivity of 5 mS/cm is found at 10% Y, whereas p-type conductivity increases with increasing yttrium concentration. A conductivity component appearing at low oxygen partial pressures decreases with yttrium doping. The substoichiometric material showed a drop in unit cell volume of approximately 0.34 \AA^3 compared to its stoichiometric partner. The conductivity components of substoichiometric material are higher than the conductivities of corresponding stoichiometric material, being approximately 7 mS/cm for both $P_{\text{H}_2\text{O}}$ levels.

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