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Enhanced surface-ion conduction of Pr-doped CeO_2 for advanced energy conversion technology

Yanyan Liu
KTH Royal Institute of Technology, Sweden

The surface ion transport characterizations are receiving increasing attention owing to their dramatical impacts on the efficiency and durability of the electrochemical energy conversion devices, such as solid oxide fuel cells (SOFCs). Briefly, the realized fuel cell function relies on the ion exchange in the interfaces between electrode surface and gas phase, as well as the subsequent charge carrier, e.g. O^{2-}, transfers through the electrolyte towards another electrode. Sufficiently high ionic conduction of electrolyte is typical requirement to achieve excellent fuel cell performance at low temperature. Herein, we report a Pr-doped ceria material focusing on its surface-ion conducting properties resulting in a high ionic conductivity. The redox couple of Pr^{3+}/Pr^{4+} make contribute to the extraordinary ionic conductivity. A 'sandwich' configuration fuel cell device was fabricated using this Pr-doped ceria as electrolyte, exhibiting a high power density of above 700 mW cm^{-2}. Furthermore, the mechanisms for ionic conductivity enhancement are demonstrated. The above findings reveal a joint bulk and surface doping methodology for the ceria is a feasible approach to develop new oxide-ion conductors with high impacts on advanced low temperature SOFC technology.

lyanyan@kth.se