Improving the Proton Conductivity of Yttrium-Doped Barium Zirconate Electrolytes Towards the Development of Intermediate Temperature Solid Oxide Fuel Cells

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For the widespread deployment of solid oxide fuel cells (SOFCs), the high cost is an obstacle, together with the long-term stability due to the high working temperatures. Reducing the SOFC operating temperature in the 400-700°C range can reduce fabrication costs and overall improve performance. This aim can be obtained using high temperature proton conductor (HTPC) oxides as electrolytes, due to by their lower activation energy for proton conduction (0.3-0.6 eV), with respect to oxygen-ion conductor electrolytes. Moreover, proton conductor electrolytes offer the advantage of generating water at the cathode, and thus the fuel does not become diluted during cell operation [1].

Among HTPCs, doped $BaCeO_3$ shows the largest proton conductivity, but they are not suitable for fuel cell application since they easily react with acidic gases, e.g. CO_2, and water vapor. Differently, doped $BaZrO_3$ offer excellent chemical stability against reaction with CO_2 and H_2O, but low conductivity values for sintered pellets. Their low electrical conductivity is the consequence of poor conductive grain boundary regions coupled with the material refractory nature.

This work reports the various strategies recently followed in our lab to improve the conductivity of Y-doped barium zirconate [2,3], towards the limitation of grain boundary surface, the use of co-doping for improving the sinterability, and the fabrication of films by pulsed laser deposition (PLD) [4,5].

Keywords: Y-doped barium zirconate, solid oxide fuel cells, high temperature protonic conductor.

[1] E. Fabbri, D. Pergolesi, E. Traversa, Chem. Soc. Rev., in press.
[2] A. D'Epifanio, E. Fabbri, E. Di Bartolomeo, S. Licoccia, E. Traversa, Fuel Cells **8**, 69 (2008).
[3] E. Fabbri, A. D'Epifanio, E. Di Bartolomeo, S. Licoccia, E. Traversa, Solid State Ionics **179**, 558 (2008).
[4] E. Fabbri, A. D'Epifanio, S. Sanna, E. Di Bartolomeo, G. Balestrino, S. Licoccia, E. Traversa, Energy Environ. Sci. **3**, 618 (2010).
[5] D. Pergolesi, E. Fabbri, E. Traversa, Electrochem. Comm. **12**, 977 (2010).
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