Chemically stable proton conducting electrolytes for solid oxide fuel cells operating at 600°C

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The high cost of solid oxide fuel cells (SOFCs), related to their high operating temperatures, hinders the general use of SOFCs and causes long-term stability problems. A step forward towards reducing the SOFC working temperature at 600°C or below can be the use of 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]. However, chemically stable materials are needed, especially for using carbon-based fuels, such as ethanol produced from biomasses.

We have recently made significant progresses in the electrolyte development by improving the conductivity of Y-doped barium zirconate (BZY) [2]: doped $BaZrO_3$ offer excellent chemical stability against CO_2 and H_2O reaction, but low conductivity values for sintered pellets are usually reported. We followed various strategies to improve the BZY conductivity [3], including the use of co-doping [4] and sintering aids [5] to improve its sinterability, an ionic diffusion strategy [6], and the fabrication of films by pulsed laser deposition (PLD) [7,8]. The possibility to develop a next generation of SOFCs, though, needs also the development of electrode materials [9]. The recent work in developing tailored cathode and anode materials will be also presented [10,11]. All the materials needed for the development of proton conducting electrolyte based SOFCs were deployed, promising for the next generation of SOFCs operating at 600°C.

REFERENCES

[1] E. Fabbri, D. Pergolesi, E. Traversa, Chem. Soc. Rev. **29**, 4355 (2010).
[2] D. Pergolesi, E. Fabbri, A. D'Epifanio, E. Di Bartolomeo, A. Tebano, S. Sanna, S. Licoccia, G. Balestrino, E. Traversa, Nature Mater. **9**, 846 (2010).
[3] E. Fabbri, L. Bi, D. Pergolesi, E. Traversa, Adv. Mater. **24**, 195 (2012).
[4] E. Fabbri, L. Bi, H. Tanaka, D. Pergolesi, E. Traversa, Adv. Funct. Mater. **21**, 158 (2011).
[5] Z.Q. Sun, E. Fabbri, L. Bi, E. Traversa, Phys. Chem. Chem. Phys. **13**, 7692 (2011).
[6] L. Bi, E. Fabbri, Z.Q. Sun, E. Traversa, Energy Environ. Sci. **4**, 409 (2011).
[7] E. Fabbri, A. D'Epifanio, S. Sanna, E. Di Bartolomeo, G. Balestrino, S. Licoccia, E. Traversa, Energy Environ. Sci. **3**, 618 (2010).
[8] D. Pergolesi, E. Fabbri, E. Traversa, Electrochem. Comm. **12**, 977 (2010).
[9] E. Fabbri, D. Pergolesi, E. Traversa, Sci. Technol. Adv. Mater. **11**, 044301 (2010).
[10] L. Bi, E. Fabbri, Z.Q. Sun, E. Traversa, Energy Environ. Sci. **4**, 1352 (2011).
[11] L. Bi, E. Fabbri, Z.Q. Sun, E. Traversa, J. Electrochem. Soc. **158**, B797 (2011).