

Tailoring cations in a perovskite cathode for proton-conducting solid oxide fuel cells with high performance

Xi Xu ^{a#}, Huiqiang Wang ^{b#}, Marco Fronzi ^c, Xianfen Wang ^a, Lei Bi ^{a*} and Enrico
Traversa ^{d*}

- a. Institute of Materials for Energy and Environment, College of Materials Science and Engineering, Qingdao University, Ningxia Road No.308, Qingdao 266071, China.
Email: bilei@qdu.edu.cn and bilei81@gmail.com (L. Bi)
- b. College of Mechanical and Electric Engineering, Hebei Agricultural University, Baoding 071001, Hebei, China
- c. International Research Centre for Renewable Energy, State Key Laboratory of Multiphase Flow in Power Engineering, Xi'an Jiaotong University, Xi'an, China
- d. School of Materials and Energy, University of Electronic Science and Technology of China, 2006 Xiyuan Road, Chengdu 611731, Sichuan, China.
Email: traversa@uestc.edu.cn (E. Traversa)

#: Xi Xu and Huiqiang Wang contributed equally to this paper.

*: Corresponding authors

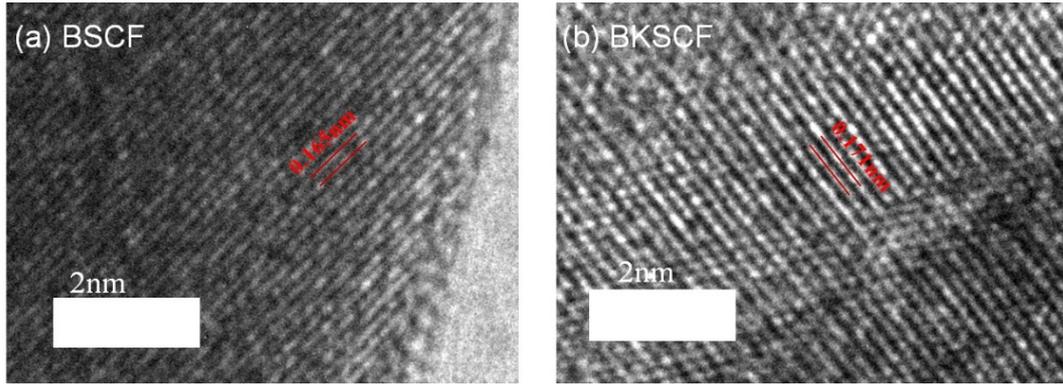


Figure S1. The HRTEM images for BSCF and BKSCF powders.

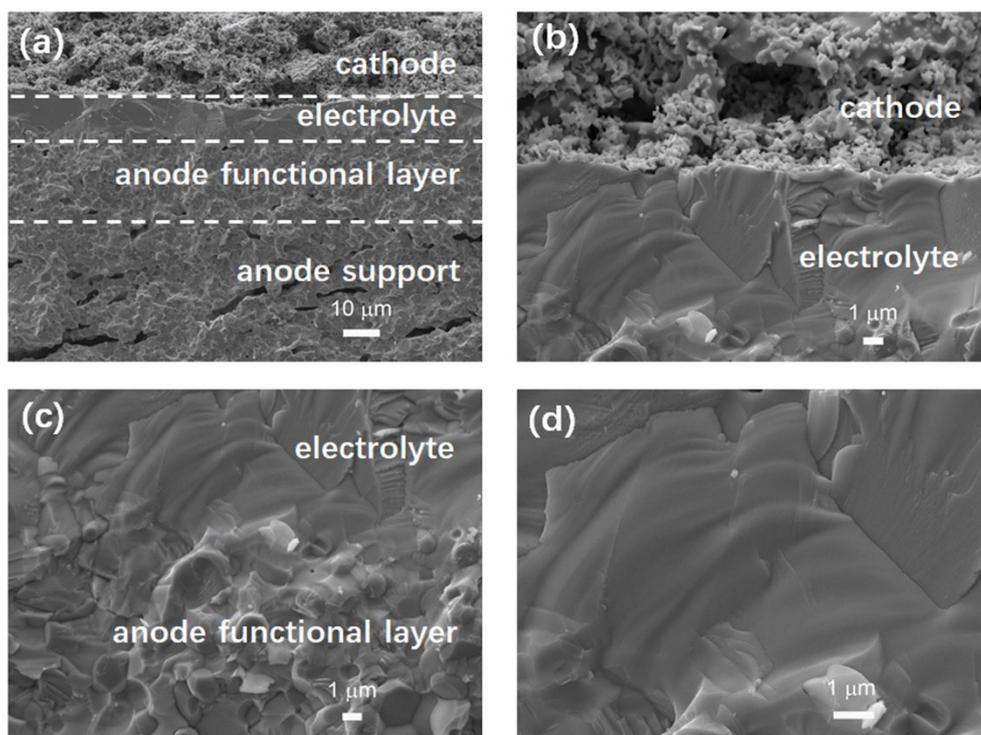


Figure S2. Cross-sectional SEM micrographs of the cell using BSCF cathode: (a) the complete cell; (b) cathode/electrolyte; (c) electrolyte/anode functional layer; (d) electrolyte.

Chemical stability of BKSCF

It is known that chemical stability is an issue for the BSCF material, and the K doping in BSCF increases its basicity, making the material more reactive with acid gases, such as CO₂.

To evaluate the influence of K-doping on the stability of BSCF, both BSCF and BKSCF, samples were treated in 3% CO₂ atmosphere (balanced with Ar) at 650 °C for 2 h. Fourier-transform infrared spectroscopy (FTIR, Thermo Scientific iS50 FT-IR) was used to characterize the materials before and after the treatment to check the formation of carbonates. One can see from Figure S3, which report the FTIR results, that no detectable carbonate peak could be observed for BSCF and BKSCF before the CO₂ treatment, suggesting no formation of carbonate for the as-prepared powders. However, obvious carbonate signals can be detected for both powders after the CO₂ treatment, suggesting that both BSCF and BKSCF can react with CO₂ forming the carbonates.

Temperature programmed desorption (TPD, Quantachrome Chembet Pulsar analyzer) tests were then performed on CO₂ pre-treated BSCF and BKSCF powders to examine their desorption behavior. Figure S4 show that the intensity of the CO₂ signal for BKSCF was higher than that for BSCF, indicating that the K-doping in BSCF makes this material more reactive with CO₂. This result is somehow expected as the partial replacement of Ba by K increases the material basicity, thus increasing its reactivity with acid gases such as CO₂.

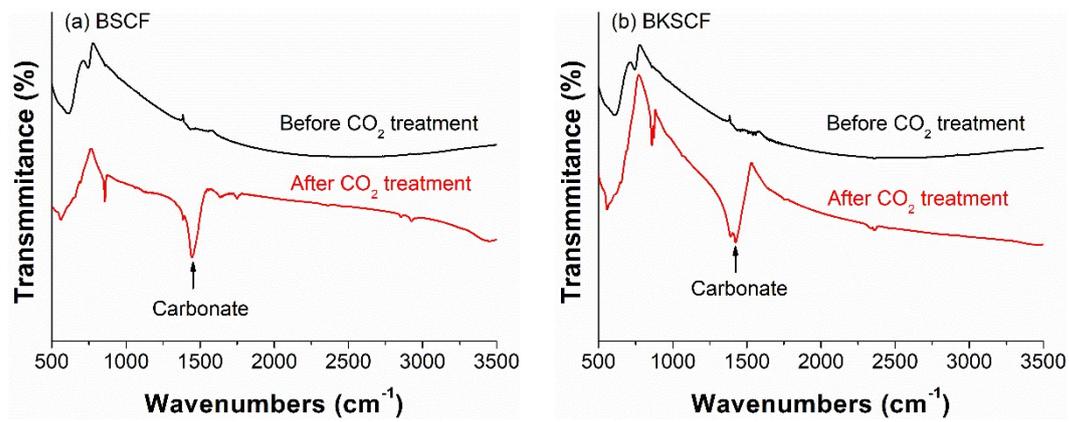


Figure S3. FTIR spectra of BSCF and BKSCF powder before and after the treatment in CO₂ atmosphere.

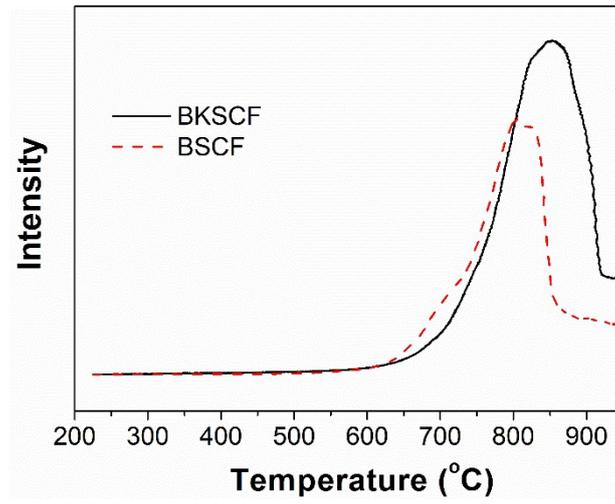


Figure S4. CO₂-TPD profiles for BSCF and BKSCF.