Surface effects governing oxygen exchange kinetics of solid oxide cell air electrodes

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Solid oxide fuel cells, solid oxide electrolyzer cells, and reversible solid oxide cells are promising future technologies for sustainable energy conversion and storage. However, development of air electrode materials for solid oxide cells (SOCs) is one of the most challenging fundamental tasks to solid-state chemistry, since successful candidates must exhibit fast oxygen exchange kinetics as well as good long-term stability – two properties that usually show opposing trends.

In the present study, the oxygen exchange kinetics of SOC air electrode materials is investigated by in-situ dc-conductivity relaxation measurements for several thousand hours under ideal as well as application-relevant conditions. Post-test analyses by complementary methods (scanning electron microscopy, scanning transmission electron microscopy, X-ray photoelectron spectroscopy) provide important insights into the mechanisms of air electrode degradation. The obtained insights are applied to develop materials with improved long-term stability and fast oxygen exchange kinetics for future applications in SOCs. Thus, it could be demonstrated that materials from the (La,Pr,Ca)$FeO_{3-\delta}$ series [1,2] exhibit exceptionally fast oxygen exchange kinetics and significantly improved long-term stability compared to $La_{0.6}Sr_{0.4}CoO_{3-\delta}$, even under accelerated ageing conditions in presence of SO_2.

[1] C. Berger, E. Bucher, C. Gspan, A. Menzel, W. Sitte, *Journal of the Electrochemical Society*, 164 (2017) F3008-F3018.

[2] C. Berger, E. Bucher, C. Gspan, A. Menzel, W. Sitte, *Solid State Ionics*, 326 (2018) 82-89.