

## Effect of porosity-graded (La,Sr)FeO<sub>3</sub>–(Ce,Sm)O<sub>2</sub> electrodes on the long-term performance of solid oxide electrolysis cell

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Solid oxide electrolysis cells (SOECs) are considered good candidates for clean energy generation and provide ~92% electricity-to-fuel efficiency [1]. However, SOECs exhibit poor performance and long-term performance degradation. The main reason for the poor SOEC performance is the shortness of triple-phase boundaries (TPBs) where oxygen evolution reaction takes place at the anode. Time-dependent performance degradation originates mostly from high oxygen partial pressure build-up at the electrode/electrolyte interface and thus, delamination. Several electrocatalyst/ionic conductor composite electrodes such as (La,Sr)FeO<sub>3</sub>–(Ce,Sm)O<sub>2</sub> (LSF-SDC) have been intensively investigated recently due to its high electrical conductivity. To maximize TPB length, researchers proposed to produce nanostructured electrocatalyst/ionic conductor composite anodes by means of depositing an ethylene glycol (EG)-based polymeric precursor.

Recently, the origin and the means to control the amount of large pores observed in EG-based polymeric precursor-derived electrode structures were determined [2–5]. This enables the fabrication of electrodes with controlled/graded porosity in polymeric precursor-derived electrode films, which could prevent oxygen pressure build up and help achieve stable SOEC air electrodes.

The current study focuses on the contribution of porosity-graded layers at the electrode/electrolyte interface to the time-dependent electrochemical performance of SOEC. To create a

functionally graded layer by changing pore size, nitric acid was utilized as a pore former. Porosity-graded LSF-SDC anodes were deposited on YSZ electrolytes by spin coating. As-prepared anodes were characterized by scanning electron microscopy (SEM), X-ray diffraction (XRD), and electrochemical impedance spectroscopy (EIS).

EIS measurements show that long-term electrochemical performance can be improved with a functional layer positioned between the electrode and electrolyte by grading the pore size.

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### References

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