Interface Structure in Solid Oxide Fuel Cells by Anomalous/High-Energy SAXS/WAXS

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Control of solid oxide fuel cell (SOFC) microstructure and chemistry is needed to optimize SOFC performance and cost. Within the composite electrodes, the variation in the triple-phase-boundary (TPB) morphology (where the gas-, electron- and ion-conducting phases all meet), as a function of distance from the electrolyte layer, is particularly significant in defining electrochemical performance. Thus, characterization of the void and phase microstructures within the anode and cathode, at sufficient resolution to infer a quantitative characterization of the TPB interface, is highly desirable. This has become possible by utilizing the high brilliance and high x-ray energies available at a 3rd generation hard x-ray synchrotron source.

Anomalous ultrasmall-angle x-ray scattering (USAXS), close to the Zr absorption edge, has been combined with high-energy small-angle and wide-angle scattering (HE-SAXS and HE-WAXS). For the first time this has provided correlated variations in void size distribution, interface surface area, and solid phase, to below 10 micrometers spatial resolution, and has enabled the ion-conducting YSZ phase to be distinguished from the voids and electron-conducting phase (LSM or Ni). From thses data, TPB properties can be inferred.

[1] Allen A.J., Dobbins T.A., Ilavsky J., Zhao F., Virkar A., Almer J., DeCarlo F., *Ceramic Engineering and Science Proc.*, 2004, **25**, 275.

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