

Advanced 3D Imaging Coupled to Modeling of Fuel Cell and Battery Electrodes

F. Tariq¹, V. Yufit¹, M. Marinescu¹, G. Cui¹, M. Kishimoto¹, N. Brandon¹

¹Imperial College London, London, United Kingdom

Abstract

Solid Oxide Fuel Cells (SOFC) and Li-ion batteries (LIB) are electrochemical devices where performance is dependent on reactions inside porous electrode microstructures; their complexity is inadequately described using 2D imaging. Here we use tomographic techniques to probe 3D electrode structures (anodes and cathodes) at micro-nanometer length scales. Subsequently, micro/nano structural changes in electrodes are characterised and quantified. Utilising 3D electrode data as geometric inputs for thermal, mechanical and fluid coupled numerical models run in COMSOL Multiphysics® 4.3a, revealed that increased strains were located at interfaces and also at microstructure constrictions for both fuel cell and battery electrodes (e.g. Figure 1). The results show nano/micro structural changes can affect the performance of electrodes. This combined experimental and modelling approach can help in establishing structure/performance relationships providing key insights important for transport, electrochemistry and strains in both anodes and cathodes and understanding sources of performance degradation. This is important to understand for designing and manufacturing future electrodes and towards meeting our increasing energy demands.

Figures used in the abstract

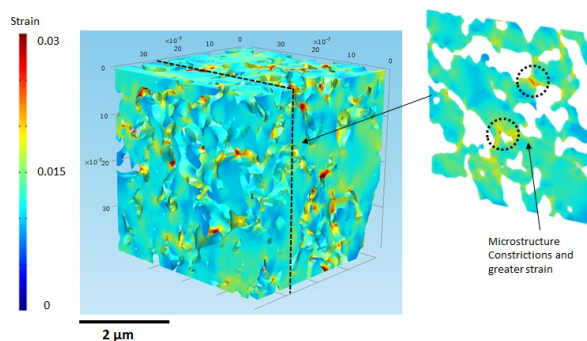


Figure 1: Strains at constrictions