Materials Poster Abstract

Exploring 3D microstructural evolution in Li-Sulphur battery electrodes using in-situ X-ray tomography

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Lithium sulphur (Li-S) batteries offer superior theoretical specific capacity, lower cost and enhanced safety compared to incumbent Li-ion battery technology. However, the multiple reaction stages and phase changes result in a multitude of challenges that significantly impact cycling life. Through the use of a suite of lab scale micro- and nano-tomography instruments available at the Electrochemical Innovation Lab, UCL, we have performed a multi-scale 3D in situ tomography study for the first time on Li-S battery chemistry, in order to characterize morphological parameters and track microstructural evolution of the sulfur cathode as a function of cycle life. This fundamental study employs a thick film, high mass loading cathode volume which allows us to observe the limitations behind thick film electrodes, with the added benefit of optimizing the cathode for X-ray imaging by enhancing the visualization of changes within bulk S particles and across the thickness of the electrode. Complementary ex situ nano-scale phase contrast imaging reveals the complex and heterogeneous microstructure of the active material and binder phases. The complexity of the reaction mechanisms within the Li-S cell require multiple characterisation methods for a more thorough understanding and within this framework, X-ray CT is shown to be a powerful tool to elucidate the solid phases within the sulfur cathode and interfaces between electrode layers.

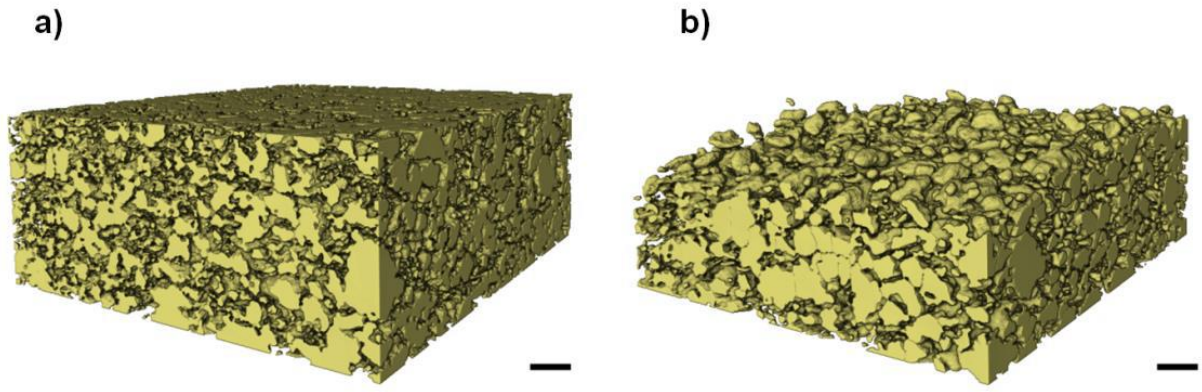

Figure 1. Volume rendering of the sulfur phase for (a) the uncycled cathode and (b) the cathode after 10 cycles. Scale bar represents 50 µm.

See overleaf for figure 2

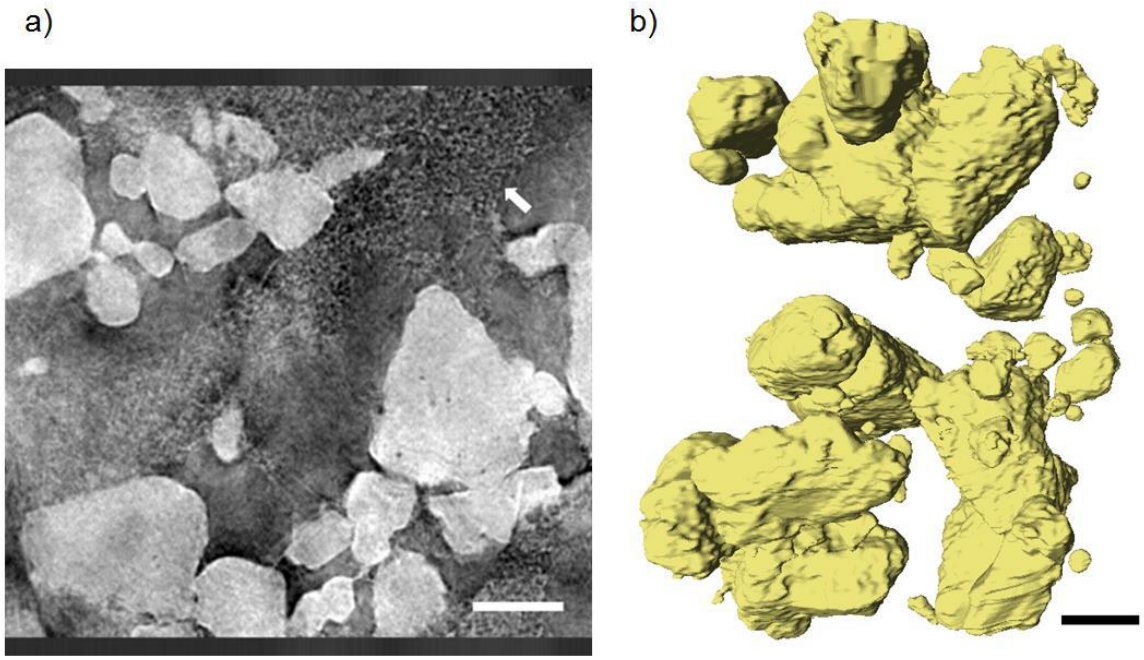

Figure 2. left (a) X-ray Zernike phase contrast nano-CT on S-composite used, carbon binder domain indicated by the white arrow; right (b) volume rendering of segmented sulfur particles. Scale bars represent 10 m.