

Energy Filtered and Quantitative High Resolution Transmission Electron Microscopy Analysis of Electrochemically Cycled LiFePO₄

M. Kinyanjui¹, A. Chuvilin¹, U.Kaiser¹,S.Ströbele², P. Axmann², C. Stinner²,M.Wohlfahrt-Mehrens²

¹ Electron Microscopy Group of Materials Science, University of Ulm, Germany

²Center for Solar Energy and Hydrogen Research, Ulm, Germany

LiFePO₄ is meant to be applied as cathode material for Li-ion Batteries. The mechanics of the lithium diffusion process and the associated structural changes are not completely understood. We have investigated electrochemically cycled LiFePO₄ cathode material using energy filtered electron microscopy (EFTEM) and quantitative high resolution microscopy (Q-HRTEM). A lithium map from one of the grains is shown in Fig 1(a) where areas with dark contrast represent the lithium-depleted region. Structural variations were then analyzed from high resolution images (HRTEM) using the Geometric Phase Analysis method (GPA) [1]. A HRTEM image (see Fig 1(b)) from the same particle is decomposed into the spatial frequencies representing interplanar distances within the structure and structural variations are then calculated.

Fig 1(c) shows the variations in calculated cell volume as a function of position within the grain. A ~5 % difference in cell volume is determined between the delithiated and non-delithiated regions. A correlation between these results and the delithiation process will be presented

Reference:

[1] M. J. Hytch, E. Snoeck and R. Kilaas, *Ultramicroscopy*, 74, 3, 1 (1998) 131-146

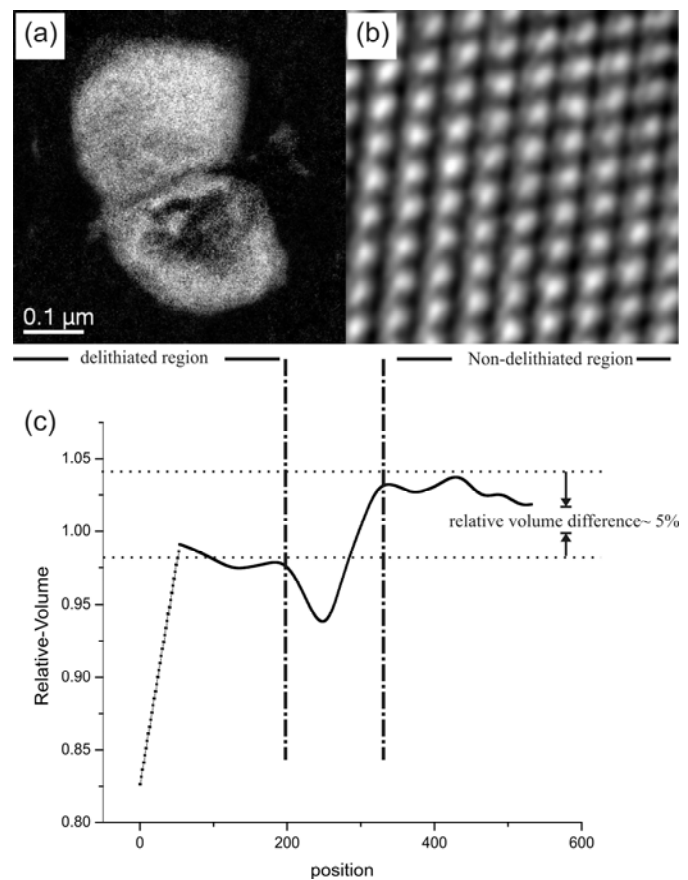


Fig 1: (a) Li map, dark contrast shows Li-depleted regions (b) HRTEM image (c) Calculated cell volume variation as a function of position and Li concentration.