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Cross-sectional Characterization of All Solid State Thin Film Lithium Ion Batteries by Analytical Transmission Electron Microscopy ZHIPENG LI, SHINTARO YASUI, JOYSURYA BASU, DMITRY RUZMETOV, National Institute of Standards and Technology, ALEC TALIN, Sandia National Laboratories, ICHIRO TAKEUCHI, University of Maryland, College Park, LEONID BENDERSKY, National Institute of Standards and Technology — Recent years witnessed the fast development of microelectronic and micro energy storage devices, which require new batteries with lightweight and high energy densities. All solid state lithium ion batteries are considered as a promising candidate for power supply of such devices. In this study, all solid state thin film lithium ion batteries, consisting of a $LiLaTiO_3$ electrolyte, $Li_4Ti_5O_{12}$ anode, and $LiCoO_2$ or compositionally graded $Li(Mn/Ni)O_x$ cathodes, were fabricated by a pulsed laser deposition technique. Cross-sectional microbatteries were prepared by focus ion beam and traditional TEM sample preparation techniques. Detailed microstructures of microbatteries were performed using analytical TEM. Multilayer thin films of batteries were epitaxially grown on Nb doped SrTiO3 substrates which serve as current collectors. Microstructures of electrolyte and electrodes, and interfacial diffusions were studied before and after charge-discharge cycling. The mechanism of cycling-triggered microstructural evolution was elucidated accordingly. These findings can not only help improve the understanding of reliability of thin film battery fabrication/assembling processes, but also shed light on issues of battery degradation. This study technically lays the foundation for our ongoing work on in-situ investigation of microbattery cycling in TEM.

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