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In situ analysis of capacity fade in thin-film anodes for high performance Li-ion all-solid-state batteries MARINA S. LEITE, CHEN GONG, Department of Materials Science and Eng., Institute for Research in Electronics and Applied Physics, Univ. of Maryland, College Park, Maryland 20742, DMITRY RUZMETOV, Sensors and Electron Devices Directorate, US Army Research Laboratory, Adelphi, Maryland, Material Measurement Laboratory, NIST, Gaithersburg Maryland, A. ALEC TALIN, Sandia National Laboratories, Livermore, California 94550 — There is still a pressing need to understand how the solid-interfaces in Li-ion all-solid-batteries form, including their chemical composition and electrical characteristics. In order to resolve the origin of the degradation mechanism in Al anodes, we combine in situ scanning electron microscopy in ultra-high vacuum with electrochemical cycling, in addition to ex situ characterization of the morphological, chemical, and electrical changes of the Al anodes upon lithiation. An AlLi alloy capped by a stable Al-Li-O is formed on the top surface of the anode, trapping Li, which results in the capacity fade, from 48.0 to 41.5 $\mu\text{Ah}/\text{cm}^2$ in two cycles [1]. The addition of a Cu capping layer is insufficient to prevent the device degradation because of the fast Li diffusion within Al. Yet, Si present extremely stable cycling: >92% of capacity retention after 100 cycles, with average Coulombic efficiency of 98% [2]. Our in situ measurements represent a new platform for probing the real-time degradation of electrodes in all-solid-state batteries for energy storage devices. [1] M.S. Leite et al., J. Mater. Chem. A, **2**, 20552 (2014). i-Cover. [2] C. Gong et al., ACS Appl. Mater. Interfaces, 2015. DOI: 10.1021/acsami.5b07058

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