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Neutron depth profiling and GD-OES as tools for characterization of Li plating in Si/graphite anodes from Li-ion battery cells

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The loss of Li inventory is a common aging mechanism in Li-ion batteries. To better understand these underlying reversible and irreversible degradation processes in Si/graphite electrodes, depth-resolved methods need to be used to obtain information on the decomposition products of the lithium-containing electrolyte across the electrode thickness. In this work we present two Post-Mortem analytical methods, which can be used to obtain quantified Li depth profiles to depths bigger than 10 μm from the electrode surface, the neutron depth profiling (NDP) and glow discharge optical emission spectroscopy (GD-OES). The validation of GD-OES using NDP by examining the Si/graphite anodes from cylindrical 21700 cells is presented. These two methods are complementary to each other since they are based on different measurement principles and an improvement for the GD-OES calculations of depth profiles of Li in electrodes has been established. It has been demonstrated that the preferential sputtering can occur on the anode surface during the GD-OES measurements. This phenomenon is caused by the higher sputter rate of Li, as it is mainly present in the Li plated layer or in the solid electrolyte interface (SEI).

Primary authors: PIVARNIKOVA, Ivana; WOHLFAHRT-MEHRENS, Margret; FLÜGEL, Marius; Dr PAUL, Neelima (Technical University of Munich, Heinz Maier-Leibnitz Zentrum (MLZ)); CANNAMO, A; CECCIO, Giovanni; VACIK, J; MÜLLER-BUSCHBAUM, Peter (Technical University of Munich, TUM School of Natural Sciences, Department of Physics, Chair for Functional Materials); GILLES, Ralph; WALDMANN, Thomas (Zentrum für Sonnenenergie- und Wasserstoff-Forschung Baden-Württemberg (ZSW))

Presenter: PIVARNIKOVA, Ivana