A novel electrochemical approach for quantitative characterization of side reactions on lithium metal anodes: CTTA

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Lithium-ion batteries (LiBs) have become a critical component of countless devices we use in our daily life, and they are predicted to play a pivotal role in electrification of transport (and grid energy storage) in the near future. In order to enable a widespread energy transition, the development of advanced battery technologies is crucial. Ideally, electrode materials should have high specific charge capacities, enable high cell voltages and allow fast charge and discharge kinetics. In this sense, the most promising anode active material would be lithium metal since it has a specific charge capacity of 3860 mAh g^{-1} and operates at the lowest electrode potential possible (i.e., 0 V vs. Li^+/Li, or –3.04 V vs. the standard hydrogen electrode). All-solid-state batteries (ASSBs) are quite promising to enable the use of lithium metal anodes due to their projected safety characteristics (e.g., non-flammable components, mechanical rigidity, very high transference numbers). Unfortunately, most solid electrolytes have a narrow electrochemical stability window (ESW) and thus are subject to parasitic side reactions with lithium metal resulting in accelerated cell failure. It is essential to understand the chemical and quantitative nature of such reactions (and their kinetics) to design better performing battery systems. In this talk, it will be presented how the use of electrochemical methods (such as the novel CTTA method) and advanced analytical characterization methods (e.g., XPS, ToF-SIMS, FIB-SEM, operando HAXPES, etc.) can be used to obtain fundamental understanding of degradation reactions occurring at the interface between lithium metal and solid electrolyte in all-solid state batteries (with a particular focus on argyrodite-type sulfide-based solid electrolytes).

Burak Aktekin received his BSc (2010) and MSc (2013) in Metallurgical and Materials Engineering Department in Middle East Technical University. He then joined Uppsala University for his doctoral studies where he worked on the high voltage spinel type positive electrodes for LiBs. Having obtained his PhD in late 2019 and following a brief postdoctoral period at Uppsala University, Dr. Aktekin joined J. Janek’s research group at the Institute of Physical Chemistry, Justus Liebig University Giessen. His current research activities focus on understanding interfacial side reactions in all-solid-state batteries using electrochemical methods as well as a range of analytical tools available in house or in synchrotron facilities