Solid Electrolytes and the Development of All-Solid State Batteries

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Research on solid electrolytes (SE) and all-solid state batteries (ASSB) is currently accelerating, as ASSB are considered as an attractive concept in the quest for advanced and high performance electrochemical storage [1-3]. Main reasons for this increasing interest are the expected stability at elevated temperature, improved safety, the hope for increased energy density due to the potentially safe use of the lithium metal anode and for fast kinetics due to the single-charge carrier character of inorganic solid electrolytes.

Firstly, the choice of the SE is discussed, highlighting the search for SE with very high Li ion conductivity. The stability of SE at anode and cathode potentials plays a critical role in full cells and is included in the discussion. Secondly, the role of anode and cathode solid/solid interfaces is considered, and thirdly, the current status of ASSB full cells is presented.

Own experimental results on lithium thiophosphate SE and their stability in contact with typical anode and cathode materials will be presented, and the role of SEI formation in contact of SE with lithium metal will be highlighted. As volume changes of active materials lead to strain in full cells, the chemo-mechanics of active materials and SE is discussed in depth. Further details of interest are microstructure of SE/CAM composites, degradation mechanisms of ASSB and the kinetics of the Li metal anode.

Finally, own data and literature data on the performance of ASSB will be summarized in order to critically assess the potential of ASSB as future high-performance storage devices.

References:

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