Towards recycling of thiophosphate-based all-solid-state lithium-ion batteries

Kerstin Wissel[1], Wolfgang Ensinger[1], Oliver Clemens[2]

[1] Technische Universität Darmstadt, Institut für Materialwissenschaft, Fachgebiet Materialanalytik, Darmstadt, Germany

[2] Universität Stuttgart, Institut für Materialwissenschaft, Abteilung Chemische Materialsynthese, Stuttgart, Germany

In light of the trend to mobile electrification, also prompted by the increasing popularity of electric vehicles, escalated demands for lithium-ion batteries will arise. With this, sustainable battery recycling strategies will be of growing urgency. Current research efforts aim, furthermore, at the development of various next-generation battery technologies, of which all-solid-state batteries based on thiophosphate electrolytes are highly promising. Compared to current recycling strategies of commercial organic liquid electrolyte-based lithium-ion batteries, which face difficulties in recovering the liquid electrolyte and lithium, higher material recovery efficiencies might be possible for all-solid-state batteries. There is, however, still a lack of studies on recycling of such batteries.

In this work, a direct regeneration of thiophosphate electrolytes via dissolution and re-precipitation of the electrolyte in different organic solvents is investigated. Additionally, the separation of the electrolyte from the electrode materials by density using heavy liquids as separation medium is studied. Recovery of the precious materials of the electrode materials will be pursued via a hydrometallurgical treatment in a later step.