An overview on polymer-based electrolytes with high ionic mobility for safe operation of solid-state batteries

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The transformation from liquid- to solid-state architecture is expected to improve safety, fabrication, and temperature stability of energy storage devices, particularly if constraints of low ionic conductivity, low cation transport properties and stringent processing conditions are overcome [1].
Here, an overview is offered of the recent developments in our labs on innovative polymer-based electrolytes allowing high ionic mobility, particularly attractive for Li-metal batteries, and obtained by different techniques, including solvent-free UV-induced photopolymerization. Electrochemical performances in lab-scale devices can be readily improved using different kind of RTILs or other specific low-volatile additives. Cyclic voltammetry and galvanostatic charge/discharge cycling coupled with electrochemical impedance spectroscopy exploiting different electrode materials (e.g., LFP, Li-rich NMC, Si/C) demonstrate specific capacities approaching theoretical values even at high C-rates and stable operation for hundreds of cycles at ambient temperature [2,3]. Direct polymerization procedures on top of the electrode films are also used to obtain an intimate electrode/electrolyte interface and full active material utilization in both half and full cell architectures. In addition, results of composite hybrid polymer electrolytes, as well as new single-ion conducting polymers are shown [3,4], which are specifically developed to attain improved ion transport and high oxidation stability for safe operation with high voltage electrodes even at ambient conditions.

References

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