In situ Deprotection of Polymeric Binders for Solution-Processible Sulfide-based All-Solid-State Batteries

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Sulfide-based all-solid-state batteries (ASSBs) have been featured as promising alternatives to the current lithium-ion batteries (LIBs) mainly owing to their superior safety. Nevertheless, a solution-based scalable manufacturing scheme has not yet been established because of the incompatible polarity of the binder, solvent, and sulfide electrolyte during slurry preparation. Herein, we overcome this dilemmatic issue by subjecting the acrylate (co)polymeric binders to protection-deprotection chemistry. Protection by the tert-butyl group allows for homogeneous dispersion of the binder in the slurry based on a relatively less polar solvent, with subsequent heat-treatment during the drying process to cleave the tert-butyl group. This exposes the polar carboxylic acid groups, which are then able to engage in hydrogen bonding with the active cathode material, high-nickel layered oxide. Deprotection strengthens the electrode adhesion such that the strength equals that of commercial LIB electrodes, and the key electrochemical performance parameters are improved markedly in both half-cell and full-cell settings.