High Aspect Ratio Nanofillers for Solid Polymer Electrolytes

LALITHA GANAPATIBHOTLA, JANNA MARANAS, The Pennsylvania State University — In this study, we explore high aspect ratio nanofillers as additives that enhance solid polymer electrolyte (SPE) conductivity at battery working temperatures. SPEs are the key to light-weight and energy-dense lithium ion batteries but suffer from low room temperature ion conductivities. Spherical ceramic fillers are known to improve SPE conductivity and mechanical properties. Our experiments on spherical Al2O3 particle filled SPEs indicate highest conductivity enhancement at eutectic composition and temperature. A new mechanism, via stabilization of alternating layers of PEO and highly conducting PEO6:LiClO4 tunnels at the filler surface, was suggested by us. More such structures would be stabilized at a filler surface with high aspect ratio. Consistent with this hypothesis, γ-Al2O3 nanowiskers intensify the effect of γ-Al2O3 nanoparticles. Increase in conductivity at eutectic composition, and decrease at non-eutectic compositions is more than the nanoparticles. Diameters of the two fillers are similar, but the change in aspect ratio (1to100) improves conductivity by a factor of 5. The influence of morphology and PEO dynamics on conductivity enhancement will be presented. All measurements are performed at a series of Li compositions, temperatures and nanowisker loadings.

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