abstract

Solid electrolytes have great potential to address the safety issues of Li-ion batteries, but better synthesis methods are still required for ceramics electrolytes such as lithium lanthanum titanate (LLTO) and lithium lanthanum zirconate (LLZO). However, pellets made from ceramic nanopowders can be porous using conventional sintering caused by the agglomeration of nanoparticles. Electrospinning is a simple and versatile technique for preparing oxide ceramic nanowires. LLTO and LLZO nanowires were synthesized successfully using electrospinning. Pellets prepared from the electrospun LLTO nanowires had higher density, less void space, and higher Li+ conductivity compared to those comprised of LLTO prepared with conventional sol-gel methods, which demonstrated the potential that electrospinning can provide towards improving the properties of sol-gel derived ceramics. Cubic phase LLZO was stabilized at room temperature in the form of electrospun nanowires without extrinsic dopants. Bulk LLZO with tetragonal structure was transformed to the cubic phase using particle size reduction via ball milling. Heating conditions that promoted particle coalescence and grain growth induced a transformation from the cubic to tetragonal phases in both types of nanostructured LLZO. Composite polymer solid electrolyte was fabricated using LLZO nanowires as the filler and showed an improved ionic conductivity at room temperature. Doping did not have significant effect on improving the overall conductivity as the interfaces played a predominant role. By comparing fillers with different morphologies and intrinsic conductivities, it was found that both nanowires morphology and high intrinsic conductivity are desired.