High Ionic Conductivity Ionic Liquid-based Polymer Electrolytes via Surfactant-assisted Polymerization at the Plasma-Liquid Interface

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To achieve high ionic conductivity polymer electrolyte, ionic liquids (ILs) have been incorporated into a mechanical polymer matrix to form solid-state IL-incorporated polymer. We developed a new method, named interfacial liquid plasma polymerization, to directly polymerize ionic liquids (ILs). These IL-based polymers were formed through polymerization process of ionic liquids and ethylene oxide-based surfactants to the polyelectrolyte matrix using atmospheric pressure plasmas. We found that fluoroborate or halide anions of ILs together with the small amount of Triton X100 is necessary to form crosslinked network structures of the polymer electrolyte. Interestingly, the thickness of the synthesized polymer decreased with increasing the Triton X100 molar content in initial reaction solution. The increase of the Triton X100 molar content also resulted in the decrease of the ionic conductivity of polymer electrolytes. The synthesized solid-state IL-based polymer showed the highest ion conductivity of 2.28×10-3S.cm-1 at room temperature. Through systematic investigations, we proposed the formation mechanism of IL-based polymer film through interfacial liquid plasma polymerization.