A highly ion-conductive amphiphilic nanostructured block-graft copolymer electrolyte for solid-state flexible supercapacitors

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An amphiphilic nanostuructured polymer electrolyte with high ionic conductivity and mechanical stability for solid-state flexible supercapacitors is reported. These improvements are obtained by using a block-graft copolymer, i.e., poly(styrene-b-butadiene-b-styrene)-g-poly(oxyethylene methacrylate) (SBS-g-POEM) synthesized via facile one-pot free-radical polymerization. The hydrophobic SBS domains as the main chains are expected to provide good dimensional strength while the hydrophilic POEM side chains improve ion conducting properties. Preferential interactions of POEM with a lithium salt and interconnected microphase-separated nanostructure were observed. By changing the grafting ratio of SBS to POEM, the concentration of components, the POEM side chain length, and the operating temperature, a structure-property relationship was systematically investigated. Moreover, solid-state flexible supercapacitors with SBS-g-POEM electrolytes using carbon-based electrodes on carbon paper substrates were fabricated, which exhibited much higher performance than with the conventional PVA/H_3PO_4 electrolytes.