Proton Conducting Composite Membranes Consisting of PVC-g-PSSA Graft Copolymer and Heteropolyacid

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A series of organic-inorganic composite membranes from poly(vinyl chloride) (PVC) graft copolymer electrolyte and heteropolyacid (HPA) were prepared for proton conducting membranes. First, poly(vinyl chloride)-g-poly(styrene sulfonic acid) (PVC-g-PSSA) was synthesized by atom transfer radical polymerization (ATRP) using direct initiation of the secondary chlorines of PVC. HPA nanoparticles were then incorporated into the PVC-g-PSSA graft copolymer though the hydrogen bonding interactions, as confirmed by FT-IR spectroscopy. The proton conductivity of the composite membranes increased from 0.049 to 0.068 S/cm at room temperature with HPA contents up to 0.3 weight fraction of HPA, presumably due to both the intrinsic conductivity of HPA particles and the enhanced acidity of the sulfonic acid of the graft copolymer. The water uptake decreased from 130 to 84% with the increase of HPA contents up to 0.45 of HPA weight fraction, resulting from the decrease in number of water absorption sitesdue to hydrogen bonding interaction between the HPA particles and the polymer matrix.