Composite Fuel Cell Membranes Based on Proton Conducting Hybrid Silica Paticles

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The composite membranes were prepared by inserting polystyrenesulfonic acid-grafted silica particles into polymer matrix of sulfonated poly(arylene ether sulfone) copolymer. Atom transfer radical polymerization techniques are used in order to obtain modified silica particles grafted with sodium 4-styrenesulfonate, referred to as PSSA-g-SiO_2. Sulfonated poly (arylene ether sulfone) copolymer is synthesized via nucleophilic step polymerization of sulfonated 4,4'-dichlorodiphenyl sulfone, 4,4'-dichlorodiphenyl sulfone. The copolymer is blended with various amounts of PSSA-g-SiO_2 nano-particles to form organic-inorganic composite membranes. The composition and incorporation of the sulfonated repeat unit are confirmed by 1H NMR. The water uptake, proton conductivity, and thermal decomposition temperature of the membranes are measured. The silica content in the polymer matrix is evaluated as a function of membrane performances. All composite membranes show better water uptake and proton conductivity than the unmodified membrane. Moreover, the membranes are tested in a commercial single cell in humidified H_2/air conditions.