Facile Synthesis of Quadruple Hydrogen-bonded Polymer Electrolytes for Dye-sensitized Solar Cells

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Dye-sensitized solar cells (DSSCs) have generated considerable research interest because of high-energy conversion efficiency (~ 11 %) and low production cost. Among them, DSSCs employing solid polymer electrolytes have paid much attention because they exclude many problems such as leakage, evaporation of solvent, high-temperature instability and flammability. Here we report on the facile synthesis of a supramolecular electrolyte designed for use in DSSCs by modifying low molecular weight polyethylene glycol at both chain ends with functional groups having quadruple hydrogen bonding sites. The coil size in dilute solutions of this electrolyte is small enough for the electrolyte to penetrate into the nanopores of the TiO2 layer, resulting in improved interfacial contact between the dye-adsorbed TiO2 nanoparticles and the electrolyte, but the electrolyte becomes non-fluidic and has the necessary mechanical strength in the solid state. The overall conversion efficiencies of these DSSCs are discussed in correlation with the interfacial contact of electrolytes and TiO2 layer and the ionic conductivity of polymer electrolytes.