High-efficiency quasi-solid-state dye-sensitized solar cells using hybrid electrolytes prepared from ionic liquid-grafted Al_2O_3

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Alumina (Al2O3) nanoparticles were covalently surface-modified with an ionic liquid (IL) to improve their miscibility with ILs such as 1-methyl-3-propylimidazolium iodide (MPII). Hybrids consisting of MPII and the surface-modified IL-Al2O3 nanoparticles were utilized as an I2-free electrolyte for quasi-solidstate dye-sensitized solar cells (DSSCs). The energy conversion efficiencies of the DSSCs fabricated with IL- Al2O3 nanoparticles were always greater than those with unmodified Al2O3. The higher efficiency resulted from an increase in the value of Jsc, which was related to an increase in the iodide ion concentration and the formation of an interconnected channel pathway for ion transport. The higher mobility of the electrolyte and better electrode/electrolyte interfacial contact facilitated charge carrier transfer in the DSSCs, as revealed by EIS and IMPS/IMVS measurements. Upon utilizing double-layer structures with mesoporous TiO2 beads, the efficiency increased to 7.6% at 100 mW cm-2, one of the highest values reported for quasi-solid-state DSSCs.