Interconnected and mesoporous TiO_2 films with bimodal porosity using surface modification of nanoparticles by graft polymerization and sol-gel process

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The combined process of graft/crosslink polymerization and sol-gel process has been applied into 100nm-sized TiO_2 nanoparticles with an anatase/rutile mixed phase.To be specific, the surface of TiO_2 nanoparticles were modified first by grafted hydroxyethyl methacrylate (HEMA) and sulfosuccinic acid (SA) and further polymerization was followed to make poly(hydroxyethyl methacrylate) (PHEMA). In the next sol-gel process, the TiO_2 precursor, titanium(IV) isopropoxide (TTIP) was coordinated with PHEMA polymer domain and generated 3-dimensionally interconnected TiO_2 films with hierarchical pores. In particular,four different TiO_2 photoelectrodes(labeled such aspristine TiO_2, TiO_2/TTIP, TiO_2-HEMA/TTIP and TiO_2-PHEMA/TTIP) were prepared for dye sensitized solar cells(DSSC). The energy conversion efficiency of a polymer electrolyte (PEGDME/SiO_2/MPII/I_2)DSSC fabricated with TiO2-PHEMA/TTIP photoelectrode reached 3.5% at 100 mW cm^{-2}, which was much higher than those of pristine TiO_2 (1.4%), TiO_2/TTIP (1.6%) and TiO_2-HEMA/TTIP (2.0%) photoelectrodes.