Cost-efficient, Rubbery Amphiphilic Comb-like Copolymers for Mesoporous TiO_2 Films in Solid-state Dye-sensitized Solar Cells

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One-step free radical polymerization was employed for the synthesis of cost-efficient and rubbery amphiphilic copolymers with hydrophilic poly(oxyethylene methacrylate) (POEM) and hydrophobic poly(lauryl methacrylate) (PLMA). The successful synthesis of PLMA-POEM was identified with Fourier transform infrared spectroscopy (FT-IR), H nuclear magnetic resonance (H-NMR) and gel permeation spectroscopy (GPC). Anatase mesoporous TiO_2 films were formed by using PLMA-POEM copolymers as structure-directing agent. Morphology of TiO_2 films were controlled by adjusting precursor and molecular weight of polymer. Scanning electron microscopy (SEM), grazing incidence small-angle X-ray scattering (GI-SAXS) and N_2 adsorption desorption measurement were employed for analysis of worm-like structure. For 2 μm-thick TiO_2 film, the highest efficiency of 4.2% was obtained, and for 7 μm thick with layer-by-layer method, it was improved to 5.0%. It was much larger than commercial TiO_2 paste (3.9%).