

One-Step Preparation of Two-Dimensional, Disk-Shaped TiO<sub>2</sub> for Dye-Sensitized Solar Cells

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We report a novel, one-step preparation of two-dimensional (2D), disk-shaped TiO<sub>2</sub> (DS-TiO<sub>2</sub>) scattering layer with ethyl cellulose (EC), titanium isopropoxide (TTIP), and solvents. Especially, the planar structure of EC was utilized as the template to prepare DS-TiO<sub>2</sub> light scattering layers. The DS-TiO<sub>2</sub> paste was prepared by dissolving EC and the addition of TTIP sol-gel, and directly doctor-bladed on substrate. Also, the disk-shaped structure was well-developed due to the poor interaction of toluene with TTIP sol-gel solution. The quasi-solid-state dye-sensitized solar cells (qssDSSCs) with a DS-TiO<sub>2</sub> scattering layer on a commercial nanocrystalline TiO<sub>2</sub> (NC-TiO<sub>2</sub>) photoanode and a nanogel electrolyte, exhibited an energy conversion efficiency of 5.0 % without any TiCl<sub>4</sub> treatment, much higher than that of only NC-TiO<sub>2</sub> photoanode (4.2 %). Moreover, a high efficiency of 6.6 % was achieved using solid-state polymerized ionic liquid electrolyte (PIL) due to the high mobility of electrolyte and large interstitial pores between DS-TiO<sub>2</sub> nanoparticles. The DS-TiO<sub>2</sub> layer exhibited an excellent light scattering ability to scattering the light back into the nanocrystalline TiO<sub>2</sub> layer, and in turn, it resulted in the short-circuit current density ( $J_{sc}$ ) being significantly increased.