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TiO_2 Nanocubes for Rapid Electron Transfer in Dye-Sensitized Solar Cell

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This paper reports syntheses of TiO_2 nanocubes and theirs application to DSSC. We synthesized TiO_2 nanocubes via solvothermal method using titanium isopropoxide (TTIP) and tetramethylammoiumhydroxide (TMAH). By adding longer alkyl chain ammonium hydroxide that slowed down the growth rate of the crystal, TiO_2 nanocubes were obtained with average particle size in the range of 40 nm to 70 nm. By TEM investigation, each particle was found to be single crystal of anatase having six-faces of (001) and {100} crystallographic planes truncated by {101} series of planes, which are clearly distinguishable from spherical nanoparticles. Among various application, utilizing nanocubes as photo-electrode in dye-sensitized solar cell, we investigated photo-electron conversion performances in comparison with spherical shaped TiO_2 nanoparticles by I-V characteristics and IPCE measurements, etc.. Photocurrent-transient analysis revealed that TiO_2 nanocubes have a higher transient electron transfer rate by more than 10 times compared with spherical particles of similar size. Fast electron transport along the cube edges having small curvature was suggested as a plausible origin of high diffusion coefficient of electron in nanocube TiO_2.