

### The controlling TiO<sub>2</sub> nanotube crystallization using the surfactant

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We have demonstrated that the use of poly(vinyl pyrrolidone) (PVP) and acetic acid during the synthesis of TiO<sub>2</sub> nanotubes (NTs) may result in a synthesis of anatase TiO<sub>2</sub> nanocrystals with exposed, chemically active (001) facet. In the present experiment, PVP in the electrolyte solution acts as a surfactant and controller of crystal growth. PVP were preferentially adsorbed onto the (101) surfaces, so the growth of (001) facets proceeded more quickly and prepared a single crystalline anatase exposing mainly the (001) plane. An enhancement in dye-sensitized solar cells (DSSCs) overall conversion efficiency is observed for the photoanode consisting of TiO<sub>2</sub> single crystalline anatase exposed (001) facets. Experimentally confirmed by dark current potential and open circuit voltage decay scans, such highly exposed (001) facets are not only favorable for more dye adsorption but also effectively retard the charge recombination process in DSSCs.