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Effect of carbon modification on the electrical, structural and optical properties of TiO2 electrodes and their performance in lab-scale dye sensitized solar cells

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<p>Carbon modified titanium dioxide nanoparticles (C:TiO2 NPs) have been synthesized by ultrasonic nebulizer spray pyrolysis (USP) and pneumatic spray pyrolysis (PSP) techniques using titanium tetraethoxide as the precursor solution. High resolution transmission electron microscopy on the NPs shows difference in lattice spacing in the NP structures prepared by the two methods – 2.02 Å for the USP NPs and an average of 3.74 Å for the PSP NPs. The most probable particle sizes are 3.11 nm and 5.5 nm respectively. The carbon doping only changes the lattice spacings of the TiO2 lattice; the most predominant plane is the (101) in TiO2 reciprocal lattice as determined from the fast Fourier transform of most of the particle images. Raman spectroscopy supported by FTIR confirms the TiO2 polymorph to be anatase with the intense phonon frequency at 153 cm-1 blue-shifted from 141 cm-1 due to both carbon doping and particle size. A modified phonon confinement model for nanoparticles has been used to extract phonon dispersion and other parameters for anatase for the first time. Electronic measurements show “negative conductance” at some critical bias voltage, which is characteristic of n-type conductivity in the carbon doped TiO2 NPs as confirmed by the calculated areas under the I-V curves. This is a necessary material property for the Grätzel type of solar cells application. Practical solar cells built from carbon doped TiO2 electrodes show up to 5 times improvement in efficiency compared to pure TiO2 electrodes of similar construction.

Level (Hons, MSc,
   PhD, other)?

phD

Consider for a student
   award (Yes / No)?

Yes

Would you like to
 submit a short paper
 for the Conference
 Proceedings (Yes / No)?

YES

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