TiO_2 nanoparticles by electrospray

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Titanium oxide (TiO_2) nanoparticles are known for their photocatalytic activity [1], among other applications. Dye-sensitized solar cells printed by electrospray often have superior performance to cells prepared by conventional methods, such as doctor blading and screen-printing [2]. In electrospray, a liquid containing either TiO_2 nanoparticles or an organometallic precursor (e.g., titanium (IV) isopropoxide (TTIP)) is atomized in a strong electrical field, by becoming a Taylor cone meniscus which ejects a stationary microjet. The jet breaks up into electrically charged droplets, which are electrophoretically deposited onto a conductive substrate [3,4,5]. Different TiO_2 particle morphologies have been reported [6]; however, the factors and mechanisms which determine those morphologies are not fully understood. In this work, we are mapping out the process parameter space to quantify the morphology dependence on the operational parameters, with the aim to improve the performance of the TiO_2 nanoparticles. We produce TiO_2 nanoparticles by calcining the dry residues of electrosprays of solutions containing organometallic precursors. Several concentrations of TTIP/ethanol were used. Although water is probably responsible for the precipitation of the titanium (as hydroxide), moisture in the electrospray ambient was found to be disadvantageous to the stability of the Taylor cone. We produced TiO_2 nanoparticles, obtaining a 70/30 anatase-rutile ratio and a size of 20-40 nm.

References

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Figures

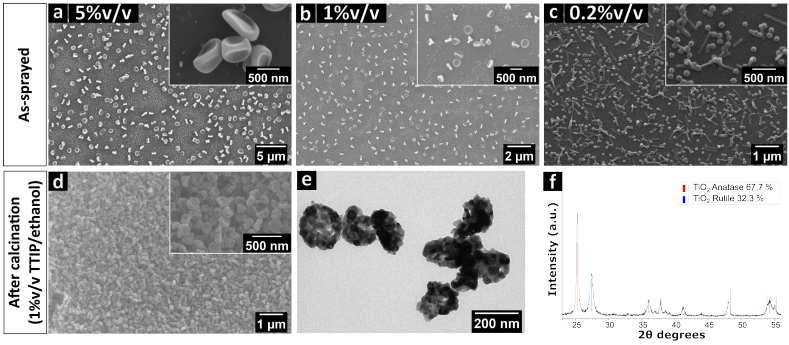

Figure 1: Electrosprayed nanoparticles at different solute concentrations in the TTIP/ethanol solution: (a,b,c) as-sprayed. For 1%v/v calcined (650ºC): (d) SEM and (e) TEM images, and (f) XRD spectra.

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