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Thick mesoporous TiO_2 nanostructured films obtained by screen-printing for application in dye-sensitized solar cells

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Abstract – Anatase TiO_2 colloidal dispersions were obtained by hydrothermal treatments (200ºC) of titanium isopropoxide gels modified with acetic acid in the presence of a non-ionic surfactant and TiO_2 mesoporous films with thickness about 10 μm for application in dye-senitized solar cells were prepared by screen-printing method. The screen-printing method allowed to prepare reproducible films with desired properties like thickness and porosity.

Dye-Sensitized Solar Cells (DSSC's) have attracted much attention as a clean alternative to solar energy conversion. These cells consist in a semiconducting-film acting as an anode, an electrolyte and a counter-electrode. The DSSC's are generally built upon titanium dioxide-based mesoporous film anodes [1]. For this application, the anatase phase of TiO_2 is considered essential for achieving high conversion efficiencies [2].Furthermore, the thickness and area control are very important to obtain reproducible DSSC's devices.

In this work, anatase TiO_2 colloidal dispersions were prepared and used to fabricate thick porous films. The dispersions were obtained by hydrothermal treatments (200ºC) of titanium isopropoxide gels modified with acetic acid in the presence of a non-ionic surfactant. Then, it was added absolute ethanol, terpineol anhydrous and ethyl cellulose in the anatase TiO_2 dispersion, resulting in 23% weight paste [3]. The pastes were spread onto F-doped SnO_2-coated glass and heat-treated at 450ºC, resulting in films with mean thickness of 10 μm (Fig. 1). The TiO_2 films present desired properties for application in DSSC's, like partial sintering of the nanoparticles, narrow particle size distribution (20 nm) and high porosity, as shown in the SEM-FEG image (Fig. 2).

We conclude that hydrothermal treatments were efficient to obtain TiO_2 colloidal dispersions and synthesized films. In addiction, reproducible films (thickness around 10 μm) were successfully prepared by the screen-printing method.

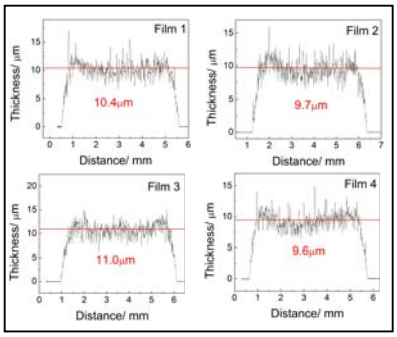

Figure 1: Profilometry of the TiO_2 films obtained.

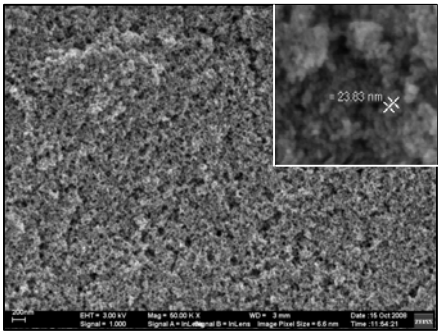

Figure 2: SEM-FEG image of the TiO_2 film heat-treated at 450°C.

References

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