Fluorine-Doped Tin Oxide Nanostructured Thin Films by Using Horizontally Spraying Technique

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1. Introduction

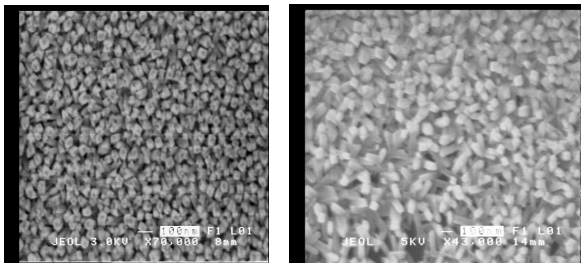
Transparent, conducting oxide (TCO) materials are widely used in making thin layers of optically-transparent and electronically-conducting coatings on glass surfaces. These thin layers are used in touch panels, frost-resistant surfaces, aircraft windshields, gas-sensors, infrared-reflective coatings, energy-efficient windows, electroluminescence, display devices and photovoltaic solar cells. 1-D nanostructures of fluorine-doped tin (IV) oxide (FTO) facilitate electron transport by providing a direct conduction pathway rather than nanoparticles and also enhance the surface area of the thin film. Therefore, A novel spray pyrolysis technique, known as Rotational, Pulsed, Atomized, Spray Pyrolysis (PAPS), was developed to prepare thin films of various nanotechnological architectures of FTO layers on glass surfaces.

2. Experimental

A precursor solution containing $SnCl_4.5H_2O$, NH_4F, distilled and de-ionized water, acetone and HCl was withdrawn horizontally, at 0.25 MPa pressure, using a pressurized air flow, with the help of a sequence of pulses of 2 s on and 13 s off. The solution–processed materials are transferred to the glass substrate by atomizing the solution and the nanostructures are formed after evaporation of the solvent.

3. Results and Discussion

The new technique allows the perfect control of morphology of nanotechnological architectures of FTO, simply by controlling spray duration. Uniformly distributed 0-D nanocrystallites, 1-D uncapped nanotubes (Fig. (a)) and 1-D capped nanorods (Fig. (b)) can be prepared on soda lime glass surfaces. The prepared nanostructured thin layers have optical transmissions in the range of 80% to 90% in the visible range. Scanning Electron Microscopy (SEM), X-Ray Diffraction (XRD) and Fourier Transform Infrared Spectroscopy (FTIR) data show excellent correlations.



(a) (b)

Fig. FTO nanostructures