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PREPARATION OF FLUORIDE-DOPED TIN OXIDE THIN FILMS USING ATOMIZED SPRAY PYROLYTIC DEPOSITION

C.S.K. Ranasinghe[1, 2], E.N. Jayaweera[1, 2], G.R.A. Kumara[2]*, R.M.G. Rajapakse[2], H.M.N. Bandara[2] and M. Okuya[3]

[1]Postgraduate Institute of Science, University of Peradeniya, Sri Lanka
[2]Department of Chemistry, Faculty of Science, University of Peradeniya, Sri Lanka
[3]Department of Electronics and Materials Science, and Research Institute of green Science and Technology, Shizuoka University, Japan
**grakumara2000@yahoo.com*

Fluoride-doped tin oxide (FTO) is considered as one of the best transparent conducting oxides (TCO) with many technological applications due to its high thermal stability, high chemical stability, high electrical conductivity and good transparent properties. Although, there are many methods available for the FTO fabrication, the conventional spray pyrolysis is still considered as the most effective and of low-cost method with less advanced technology. High temperature deposition disfavours the use of low-cost soda lime glass substrates, especially in the spray pyrolytic method. At the softening temperature (> 550 °C) of the glass substrate, various small metal cations can diffuse into the FTO layer, which affects adversely on the transmittance of the thin film. In this work, a novel, atomized spray pyrolysis (ASP) technique has been successfully used to deposit high-quality FTO thin films on soda-lime glass substrates, at 450 °C. The FTO precursor solution was prepared using $SnCl_2.2H_2O$, NH_4F and HCl in ethanol. The precursor solution was sprayed, using the ASP technique, on to a soda-lime glass substrate, heated at 450 °C. The Powder X-ray diffraction (PXRD) pattern consists of well-developed peaks at 2θ values of 26.60° (110), 33.88° (101), 37.88°(200), 51.58 °(211), 54.62°(220), 61.919°(310), and 65.78 °(301) (JCPDS card No. 01-0625), which confirms the presence of FTO. The scanning electron microscope (SEM) images shows the film morphology to be composed of particles with smaller (~50 nm) and larger (~450 nm) grain sizes. According to the cross-sectional SEM image of the FTO sample, the layer thickness is estimated to be around 560 nm. The UV-visible transmittance spectrum shows that the material has over 80% optical transmittance in the spectral range from 550 to 900 nm, which reach the maximum of 85.2% at 660 nm. The transmittance in the UV range at 300 nm is 35%, and it increases gradually to about 80% in the spectral range from 300 to 550 nm. The electrical properties of FTO film were estimated by the Van der Pauw method and Hall measurements. The FTO films have the electrical conductivity, electron mobility and the carrier density of 1.71 x 10^3 S cm^{-1}, 10.89 cm^2 V^{-1} s^{-1} and 9.797 x 10^{20} cm^{-3}, respectively, at room temperature.

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