

The effect of various precursors and solvents on the characteristics of fluorine-doped tin oxide conducting glass fabricated by ultrasonic spray pyrolysis

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Abstrak

Transparent conductive oxide (TCO) glass is one of most important components in dye-sensitized solar cell (DSSC) device. In addition to its high electrical conductivity, transparency is another important requirement that must be achieved in fabricating TCO. One TCO film is fluorine-doped tin oxide (FTO), which can be considered as the most promising substitution for indium-doped tin oxide (ITO), since the latter is very expensive. However, the fabrication techniques for TCO film need to be carefully selected; the synthesis parameters must be properly optimized to provide the desired properties. In this work, FTO glass has been fabricated by the ultrasonic spray pyrolysis technique with different precursors, i.e. tin (II) chloride dihydrate ($\text{SnCl}_2 \cdot 2\text{H}_2\text{O}$) and anhydrous tin (IV) chloride (SnCl_4), as well as different solvents, i.e. ethanol and methanol. For both conditions, ammonium fluoride (NH_4F) was used as the doping compound. The resulting thin films were characterized by use of a scanning electron microscope (SEM), x-ray diffraction (XRD), ultraviolet-visible (UV-Vis) spectroscopy and a four-point probe test. The results of the investigation show that the highest transmittance of 88.3% and the lowest electrical resistivity of $8.44 \times 10^{-5} \text{ } \Omega \cdot \text{cm}$ were obtained with the FTO glass processed with 20 minutes of spray pyrolysis deposition and 300°C substrate heating, using SnCl_4 as the precursor and methanol as the solvent. It can be concluded that TCO fabrication with tin chloride precursors and ammonium fluoride doping using ultrasonic spray pyrolysis can be considered as a simple and low cost method, as well as a breakthrough in manufacturing conductive and transparent glass.