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Effect of Substrate Temperature on Some Physical Properties of Doubly doped Tin Oxide Thin Films

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Abstract : Various transparent conducting oxides (TCOs) are mostly used much applications due to many properties such as cheap, high transmittance/electrical conductivity etc. One of the clearest among TCOs, indium tin oxide (ITO), is the most widely used in many areas. However, as ITO is expensive and very low regarding reserve, other materials with suitable properties (especially SnO2 thin films) are be using instead of it. In this report, tin oxide thin films doubly doped with antimony and fluorine (AFTO) were deposited by spray at different substrate temperatures on glass substrate. It was investigated their structural, optical, electrical and luminescence properties. The substrate temperature was varied from 320 to 480 ˚C at the interval of 40 (±5) ºC. X-ray results were shown that the films are polycrystalline with tetragonal structure and oriented preferentially along (101), (200) and (210) directions. It was observed that the preferential orientations of crystal growth are not dependent on substrate temperature, but the intensity of preferential orientation was increased with increasing substrate temperature until 400 ºC. After this substrate temperature, they decreased. So, substrate temperature impact structure of these thin films. It was known from SEM analysis, the thin films have rough and homogenous and the surface of the films was affected by the substrate temperature i.e. grain size are increasing with increasing substrate temperature until 400 ºC. Also, SEM and AFM studies revealed the surface of AFTO thin films to be made of nanocrystalline particles. The average transmittance of the films in the visible range is 70-85%. Eg values of the films were investigated using the absorption spectra and found to be in the range 3,20-3,93 eV. The electrical resistivity decreases with increasing substrate temperature, then the electrical resistivity increases. PL spectra were found as a function of substrate temperature. With increasing substrate temperature, emission spectra shift a little bit to a UV region. Finally, tin oxide thin films were successfully prepared by this method and a spectroscopic characterization of the obtained films was performed. It was found that the films have very good physical properties. It was concluded that substrate temperature impacts thin film structure.

Keywords : thin films, spray pyrolysis, SnO2, doubly doped
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