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Influence of the Molar Concentration and Substrate Temperature on Fluorine-Doped Zinc Oxide Thin Films Chemically Sprayed

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Abstract : The effect of both the molar concentration of the starting solution and the substrate temperature on the electrical, morphological, structural and optical properties of chemically sprayed fluorine-doped zinc oxide (ZnO:F) thin films deposited on glass substrates, is analyzed in this work. All the starting solutions employed were aged for ten days before the deposition. The results show that as the molar concentration increases, a decrease in the electrical resistivity values is obtained, reaching the minimum in films deposited from a 0.4 M solution at 500°C. A further increase in the molar concentration leads to a very slight increase in the resistivity. On the other hand, as the substrate temperature is increased, the resistivity decreases and a tendency towards to minimum value is evidenced; taking the molar concentration as parameter, minimum values are reached at 500°C. The attain of ZnO:F thin films, with a resistivity as low as 7.8×10-3 Ωcm (sheet resistance of 130 Ω/□ and film thickness of 600 nm) measured in as-deposited films is reported here for the first time. The concurrent effect of the high molar concentration of the starting solution, the substrate temperature values used, and the ageing of the starting solution, which might cause polymerization of the zinc ions with the fluorine species, enhance the electrical properties. The structure of the films is polycrystalline, with a (002) preferential growth. Molar concentration rules the surface morphology as at low concentration an hexagonal and porous structure is developed changing to a uniform compact and small grain size surface in the films deposited with the high molar concentrations.

Keywords : zinc oxide, chemical spray, thin films, TCO
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