

Undoped and Fluorine Doped Zinc Oxide (ZnO:F) Thin Films Deposited by Ultrasonic Chemical Spray: Effect of the Solution on the Electrical and Optical Properties

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Abstract : Undoped and fluorine doped zinc oxide (ZnO) thin films were deposited on sodocalcic glass substrates by the ultrasonic chemical spray technique. As the main goal is the manufacturing of transparent electrodes, the effects of both the solution composition and the substrate temperature on both the electrical and optical properties of ZnO thin films were studied. As a matter of fact, the effect of fluorine concentration ($[F]/[F+Zn]$ at. %), solvent composition (acetic acid, water, methanol ratios) and ageing time, regarding solution composition, were varied. In addition, the substrate temperature and the deposition time, regarding the chemical spray technique, were also varied. Structural studies confirm the deposition of polycrystalline, hexagonal, wurtzite type, ZnO. The results show that the increase of ($[F]/[F+Zn]$ at. %) ratio in the solution, decreases the sheet resistance, RS, of the ZnO:F films, reaching a minimum, in the order of 1.6 Ωcm , at 60 at. %; further increase in the ($[F]/[F+Zn]$) ratio increases the RS of the films. The same trend occurs with the variation in substrate temperature, as a minimum RS of ZnO:F thin films was encountered when deposited at $TS= 450\text{ }^\circ\text{C}$. ZnO:F thin films deposited with aged solution show a significant decrease in the RS in the order of 100 ΩS . The transmittance of the films was also favorably affected by the solvent ratio and, more significantly, by the ageing of the solution. The whole evaluation of optical and electrical characteristics of the ZnO:F thin films deposited under different conditions, was done under Haacke's figure of Merit in order to have a clear and quantitative trend as transparent conductors application.

Keywords : zinc oxide, ZnO:F, TCO, Haacke's figure of Merit

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