Morphological, surface and optical properties of spin-coated IrO_x films; influence of spin speed, annealing and (Cr, La) codoping.

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Abstract

Iridium oxide (IrO_x) is a fascinating metal oxide with superior chemical/physical properties. The present report is a try to tune the surface and optical properties of IrO_x to widen its industrial and technological applications. The influences of substrates rotational speed (RS), annealing temperature (AT), Cr-doping, and (La, Cr) co-doping on the surface morphology and wettability, structural as well as the optical properties of spin-coated IrO_x films are discussed. Raman spectra of the films show a characteristic phonon mode at 552 cm^{-1}, arising from the Ir–O_x stretching and influenced significantly by the preparative conditions (RS and AT) as well as Cr, La doping. EDX spectra were detected to confirm the chemical compositions of prepared IrO_x nanostructure thin films. FE-SEM images reveal the growth of un-doped, Cr-doped and (Cr, La) co-doped nanorod-like IrO_x structures. The annealed film at 500 ^oC and Cr-doped films showed the nanoporous nature of the grown nanorod-like structures. The films are hydrophilic and follow Wenzel Model. The wetting ability is enhanced by decreasing RS and increasing AT. Increasing RS result in increasing the transmittance (T%) owing to decreasing the films' thickness. At wavelength $\lambda = 10^3$ nm, the deposited film shows T% = 53.2 and the film annealed at 500 ^oC exhibits T% = 44.3. The optical band gap (E_g^{op}) increased with increasing RS and decreased with increasing AT. Cr-doping redshifted E_g^{op} from 2.95 to 2.85 eV, while, the co-doping with La blueshifted E_g^{op} to 3.14 eV. The effect of Cr and La doping on the optical constants of IrO_x films was investigated and compared with those of other transition metal oxide films as no data are available in the literature for IrO_x films.

Keywords: IrO_x thin films; Nanorods structure; Band gap engineering; Co-doping; Optical constants; Wettability.