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Physical properties of nebulized spray pyrolysised SnO_2 thin films at different substrate temperature(Article)

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Abstract

Using nebulized spray pyrolysis technique, we investigate tin oxide (SnO_2) thin films had been coated with different substrate temperature (300–500 °C) onto microscopic glass substrate. All the prepared films have tetragonal crystalline structure with preferential orientation (110) observed by X-ray diffraction analysis. The reduced strain due to the increase of substrate temperature from 300 to 450 °C increased the average crystalline size from 27.40 to 42.99 nm and then decreased further. All the films display high transmittance in the visible and also in IR region. As the substrate temperature had increased from 300 to 500 °C, the average transmittance of SnO_2 thin films varied between 79 and 90%. The energy band gap values had diminished from 3.91 to 3.75 eV by increasing the substrate temperature. The refractive index (n) of these films had increased from 2.11 to 2.32 with increase in substrate temperature from 300 to 450 °C and then decreased further. The optical static and high frequency dielectric constants (ε_o and ε_∞) have been determined as a role of substrate temperature. The surface morphology of these thin films exhibited polyhedron-shaped grains obtained by scanning electron microscope. Energy dispersive X-ray analysis proved the presence of Sn and O elements in the as-prepared SnO_2 films. Hall effect measurements shows that the film had deposited at 450 °C exhibited lowest resistivity 6.53×10^{-3} Ω cm and highest figure of merit 9.14×10^{-3} $(\Omega/sq)^{-1}$ among all the samples. Activation energy varied between 0.14 and 0.20 eV with the increase of substrate temperature from 300 to 500 °C. © 2018, Springer-Verlag GmbH Germany, part of Springer Nature.

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Engineering controlled terms: Activation energy, Crystalline materials, Energy dispersive X ray analysis, Energy gap, Film preparation, Oxide films, Refractive index, Scanning electron microscopy, Spray pyrolysis, Substrates, Tin oxides, X ray powder diffraction

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