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Polycrystalline Co₃O₄ thin films grown at different substrate temperature by pneumatic spray

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Abstract

Cobalt oxide thin films have attracted substantial research effort in recent years because their potential application in various technological areas. In general, cobalt oxide exists in three different crystalline forms; namely CoO, Co₂O₃ and Co₃O₄, but the latter stoichiometry is largely reported for the above cited applications because of its chemical stability and desired electrochemical properties. In this work, Cobalt oxide (Co₃O₄) thin films were deposited onto glass substrates using a (homemade) pneumatic spray pyrolysis technique (SPT) using perfume atomizer from aqueous solution of hydrated cobalt chloride salt (CoCl₂·6H₂O) as source of cobalt. The films were deposited at various substrate temperatures ranging from 250 to 450 °C in steps of 50 °C, the effect of substrate temperature on structural, electrical and optical properties was studied.

The characterization of samples was carried out by X-Ray diffraction, UV-VIS spectroscopy, scanning electron microscopy (SEM) and four probe points measurements. The X-ray diffraction study showed that all the films were polycrystalline spinel type cubic structure. The preferred orientation of the crystallites changed from (311) to (111) when the substrate temperature increases. The calculated grain sizes were in 25 to 40 nm range. The optical transmittance and the band gap energy increases with the increase of substrate temperature indicating an improvement of the crystallinity of the films. The electrical conductivity of Co₃O₄ is in the order of 10⁻² (Ωcm)⁻¹.

Keywords

thin film
pneumatic spray
Cobalt oxide
substrate temperature
properties