Synthesis and Characterization of Structural, Optical and Electrical Properties of Chromium and Nickel Doped Titanium Dioxide Thin Films

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Abstract

Un-doped and TiO_2 thin films with Cr and Ni (2, 4, 6, and 8 at.%) doping have been successfully deposited by a simple and cost-effective spray pyrolysis technique (SPT) onto glass substrate at 450 and 460 °C temperatures. Through the field emission scanning electron microscope (FESEM) images surface morphology of the films was observed and found that 6 and 8 at.% Cr-doped films display fibrous pattern with diameter 13.5 and 15.1μm, respectively and the rest of all the films are agglomerated. From XRD patterns tetragonal (anatase, 8 at.% rutile and anatase) crystal structures were found for un-doped and doped films. Un-doped film has a crystallite size 33.51 nm and for Cr-doped films 72.50 -49.85 nm and Ni-doped films carried 40.11-56.77 nm, respectively. Fizeau fringe technique used to determine the thickness of un-doped films 165 nm and for Cr-doped 180-170 nm and Ni-doped 170-190 nm, respectively. UV-Vis data were used to determine absorbance, transmittance, refractive index, dielectric constant, optical conductivity, and optical band gap. The optical band gap values are decreased from 3.40 to 2.80 eV for Cr-doped, in contrast the band gap values are increased from 3.40 to 3.58 eV for Ni-doped TiO_2 thin films. The temperature dependent resistivity has been calculated using the 4-point probe method. The resistivity of the Cr contents decreased and in contrast for Ni contents with increasing temperature.