Effects of Cd doping on structural and optical properties of TiO_2 thin films prepared by sol-gel dip coating method

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Abstract

Undoped TiO_2, 3 and 5 at.% Cd-TiO_2 thin films are prepared on glass substrate by sol–gel dip-coating technique. The structural, morphological and optical properties of the films have been investigated by X-ray diffraction (XRD), Raman spectroscopy, Atomic force microscopy (AFM) and UV–Vis spectroscopy. XRD and Raman analyzes show that the crystalline phase of TiO_2 and the Cd-TiO_2 thin films comprised only the anatase phases, no additional peak corresponding to cadmium or any other phase was observed. Atomic force microscopy images show compact and granular morphology of grains. The crystallite sizes and surface roughness of TiO_2 films increase with Cd doping .The obtained films are transparent in the visible range.Due to the doping of Cd the value of transmittance increases from 80 % to 86 %. The refractive index, thickness and optical band gap values of the films were calculated from the measured transmittance spectra. As Cd concentration increased the optical band gap was also found to be decrease from 3.53 to 3.44 eV.

Keywords: Thin films; Cd:TiO_2; Sol–gel; Optical properties; Structural properties.

Effect of temperature on the optical properties of ZnO films obtained by spin-coating method from a sol-gel

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Abstract

Zinc oxide is the widely used TCO material in both research and industry due to its low cost and abundance in nature when regarding the other TCOs.TCO are used in the manufacture of modern electroluminescence‘s diodes, solar cells and liquid crystal flat screens and in the production of coatings on architectural glass and biosensors. The electrical and optical properties of solar cells, for example,are affected by the introduction of TCO layers and these performances are improved (up to 40%).

Nowadays, the ZnO layers are manufactured by several methods: RF magnetron sputtering pulsed laser deposition, evaporation by electron beam, the molecular beam epitaxy, the chemical vapor deposition, spray pyrolysis, sol-gel, and others. Compared to other methods, a sol-gel process has many advantages:

* It is simple to perform
* A low-cost technique does not require the use of complicated and expensive equipment.

In our work, we opted for the sol-gel method that gives us the ability to produce small or large surfaces at relatively low temperatures.In addition, the sol-gel enables easy control of the solution concentration, the doping level, and the homogeneity of the solution obtained.

In the present work, ZnOwere prepared by sol-gel methodfilms with different thicknessesand deposedon glass substrates by spin coating technic. Then, followed by optical characterization by UV–visible spectrophotometer and ellipsometermachines. Zinc acetate dehydrate was used as a precursor material. The thin are annealedat various temperatures (50°C to 350°C).

The optical analyses show that with the increase of film thickness, both the refractive index and ultraviolet emission intensity are improved. However, the transmittance in the visible range is hardly influenced by the film thickness, and the averages are all above 80%.

Keywords: renewable energy, alternative sources, solar potential, Algeria