Algerian Journal of Environmental Science and Technology
March edition. Vol.8. Nº1. (2022)
ISSN : 2437-1114
www.aljest.org

Structural and optical analysis of SnO_2 thin films BY Spray Pyrolysis

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ARTICLE INFO

Article History:

Received ***: 02/02/2020***
Accepted ***: 29/09/2020***

***Key Words*:**

Thin films;
X-ray diffraction; FTIR spectroscopy;
Optical properties;
Photoluminescence spectroscopy.

ABSTRACT/RESUME

Abstract: *SnO_2 thin films were deposited by ultrasound pyrolysis spray technique at 450°C. The films were characterized by X-ray diffraction, Fourier transformed infrared (FTIR), ultraviolet–visible and Photoluminescence spectroscopy. The tetragonal rutile-type structure was confirmed by X-ray diffraction with an average crystallite size of 35 nm. In addition, the FTIR study indicated the existence of two distinct characteristic absorptions which correspond to (0-Sn-O) deformations and (O-Sn) stretching modes. For the optical properties, the band gap energy was determined by Wemple-DiDomenico model. PL properties are ascribed to the presence of intrinsic defects.*

I. Introduction

Oxides (TCO) are interesting materials because of their unique characteristics such as high electrical conductivity and high transparency which makes ideal candidates for many applications such as optoelectronics, photovoltaic and catalytic applications [1] Zinc Oxide (ZnO) & Tin Dioxide (SnO_2) are among the TCOs which offer most accurately an exceptional choice for the electronic devices synthesis on the hand [2-4]. And they are used to obtain thin films for the purpose of manufacturing solar cells, on the other hand [1]

SnO_2 is n-type semiconductor with high conductivity due to the presence of structural defects (VO) in its rutile tetragonal structure.in addition to their transparency with a gap energy of 3.6 eV at 300K [5-7] Several techniques have been used to develop tin oxide thin layers of such as sol-gel [8], pulsed laser deposition [9], RF sputtering [10] and spray pyrolysis [11-16]. The ultrasonic pyrolysis spray has many advantages, such as their simplicity to prepare thin films with large surface area from high purity materials. The obtained films have a great homogeneity, a well controlled stoichiometry, can be treated at low temperature. The best advantage is its low cost [17].

In this work, we studied the structural and optical properties, of SnO_2 thin films deposited by the ultrasound pyrolysis spray technique (USP). Theoretical relationships are used to obtain the dispersion parameters of the films from a single experimental transmission spectrum.

II. Experimental Part

II.1. Film preparation

SnO2 thin films were prepared by USP method. The utilized solution for the elaborated films has the following composition: 0.01 M of tin chloride [$SnCl_4$, $2H_2O$] (Fulka 99.9 %) is used as the Sn source; 50 ml deionized water (resistivity=18.2 MΩ.cm); 20 ml CH_3OH (Merck 99.5 %); 30 ml C_2H_5OH (Merck 99.5 %). Details are listed in the works [17]

II.2. Characterization techniques

The thin films were characterized by XRD, SEM, FTIR and optical absorption and photoluminescence properties are thoroughly studied. Structural properties recorded using diffractometer high resolution Rigaku Ultima IV powder equipped with Cu-Kα radiation (λ= 1.5418 Å). The surface morphologies of nanoparticles were