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Substrate free synthesis of wide area stannic oxide nano-structured sheets via a sol-gel method using gelatin

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Abstract

Stannic oxide nanostructured sheets (SnO_2-NS) were synthesized via a simple sol-gel method. Stannous chloride ($SnCl_2$) was used as a starting material and gelatin as a stabilizer. The structures of the prepared samples were characterized by X-ray diffraction (XRD) analysis and Raman spectroscopy. The results showed that the SnO_2-NS were crystallized in tetragonal structure. Field emission electron microscopy (FESEM) observation showed that the SnO_2-NS, with thickness of 175 nm, were grown by SnO_2 nano-grains (≈80±20) also, it was seen that the SnO_2-NS are formed only in present of gelatin. The minimum wavelength of transmission window was obtained to be 344 nm due to SnO_2-NS optical band gap (E_g=3.6 eV) from UV-vis spectrum.

Keywords: Nanocrystalline; Sol-gel preparation; particle, nanosize; Thin film

1. Introduction

Tetragonal stannic oxide, SnO_2 with rutile-like structure, is an n-type semiconductor metal oxide with a wide band gap of E_g=3.6 eV at room temperature. Also, SnO_2 is a good electron acceptor due to its small band edge about 0.5 V. Therefore, it is one of the most strategic materials used in a broad range of applications such as dye-sensitized solar cells [1], photoconductors [2], gas sensors [3, 4], batteries [5-7] super capacitors [8], and optical sensors [9], especially in nanostructured form. For these propose, various physical and chemical methods have been developed to prepare the SnO_2 nanostructures such as: nanoparticles, nanowires, and nanobelts [7, 10-14]. Among of these nanostructures, SnO_2 thin films are widely used as a conductor layer for electronic applications due to its good conductivity. Pulsed laser deposition (PLD), pulsed plasma deposition (PPD), sol-gel, and spray paralysis methods