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Influence of grown conditions on the synthesis of Vanadium Oxide thin films by Ultrasonic Spray Pyrolysis

In recent years Vanadium (V) has attracted great interest because it is an abundant element on the planet, which has different vanadium oxides as: VO, VO₂, V₂O₃, V₆O₁₃, V₃O₇ or V₂O₅, each of which has different properties. In particular, Vanadium pentoxide (V₂O₅) presents greater interest due to its chemical stability and its photocatalytic properties. V₂O₅ has an energy bandgap of ~2.3 eV, which favors photocatalytic reactions for the decomposition of contaminants in water under visible light, hydrogen production or its use as hole transport layer in solar cells [1]. Different physical and chemical methods have been used to deposit VO_x thin films, including spray pyrolysis [2]. In particular, spray pyrolysis is a low-cost and versatile method where the materials selection (solvent, precursors, additives, substrate) and the parameters optimization (molarity of solution, flow rate and spray generation) have great influence in the final properties of the films, which offers several advantages to control the morphology and growth of material [3]. In this work, nanostructured VO_x thin films are deposited by ultrasonic spray pyrolysis and the influence of precursor solution, substrate, molarity and substrate temperature is correlated with structural and optical properties. Structural and morphological properties are analysed by X-ray diffraction and scanning electron microscopy. The optical band gap was calculated from UV-vis measurements. Thickness was evaluated by profilometry, and the electrical properties was measured by a four points method. As grown samples are crystalline, but different phases are present. A thermal annealing was performed to the samples to improve the crystallinity and decrease the presence of secondary phases. The increase of molarity increases the thickness of film but decrease the homogeneity. The increase of substrate temperature from 350 to 400 °C increase the thickness and the crystallinity of films. Morphology and conductivity are dependent on the substrate used.

Keywords

Vanadium Oxide, Spray Pyrolysis, hole Transport layer, solar cells, nanomaterials

Reference

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