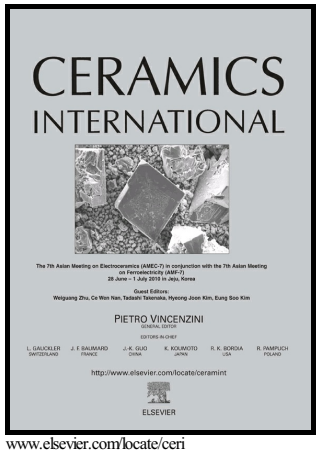

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Reversible, Repeatable and Low Phase Transition Behaviour of Spin Coated Nanostructured Vanadium Oxide Thin Films with Superior Mechanical Properties

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Abstract

Smooth, uniform and crystalline vanadium oxide thin films were grown on quartz by spin coating technique with four different rpm i.e., 1000, 2000, 3000 and 4000 and subsequently post annealed at 350, 450 and 550 °C in vacuum. Transmission electron microscopy (TEM), Field emission scanning electron microscopy (FESEM) and X-ray diffraction (XRD) techniques were utilized for microstructural characterizations and phase analysis, respectively, for vanadium oxide powder and deposited film. Nanorods were observed to be grown after annealing treatment. X-ray photoelectron spectroscopy (XPS) technique was utilized to study the electronic structure and oxidation state of deposited vanadium oxide films. Thermo-optical properties such as solar transmittance (τ_s), reflectance (ρ_s), absorptance (α_s), infrared (IR) emittance (ε_{ir}) and sheet resistance (R_s) of different thin films were evaluated. Based on the optical characteristics the optimized condition of film processing was identified to be spin coating at 3000 rpm. Subsequently, the nanoindentation technique is utilized to measure hardness and Young's modulus of the optimized film. The measured nanomechanical properties were found to be superior to those reported for sputtered vanadium oxide films. Finally, temperature dependent phase transition characteristics of optimized vanadium oxide films are studied by differential scanning calorimetry (DSC) technique. Reversible and repeatable phase transition was found to occur in the range of 44–48 °C which was significantly lower than the phase transition temperature (i.e., 68 °C) of bulk VO_2.

Keywords: *vanadium oxide thin film; XPS; reversible phase transition; DSC; optical properties; nanoindentation.*

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