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Title

Giant Phase Transition Properties at Terahertz Range in VO(2) films Deposited by Sol-Gel Method

Source

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Abstract

VO(2) films were fabricated on high-purity single-crystalline silicon substrate by the sol gel method, followed by rapid annealing. The composition and microstructure of the films were investigated by X-ray photoelectron spectroscopy (XPS), X-ray diffraction (XRD), field-emission scanning electron microscopy (FE-SEM), and atomic force microscopy (AFM). The results indicated a polycrystalline nature with high crystallinity and compact nanostructure for the films, and the concentration of +4 valence vanadium is 79.85%. Correlated with these, a giant transmission modulation ratio about 81% of the film was observed by terahertz time domain spectroscopy. The experimentally observed transmission characteristics were reproduced approximately, by a simulation at different conductivities across the phase transition. According to the effective-medium theory, we assumed that it is important to increase the concentration of +4 valence vanadium oxide phases and improve the compactness of the VO(2) films for giant phase transition properties. The sol gel-derived VO(2) films with giant phase transition properties at terahertz range, and the study on their composition and microstructure, provide considerable insight into the fabrication of VO(2) films for the application in THz modulation devices.