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Title:Giant phase transition properties at terahertz range in VO2 films deposited by sol-gel method
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Abstract:VO2 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 VO2 films for giant phase transition properties. The sol-gel-derived VO2 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. Number of references:49