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Oxygen Deficiency, Hydrogen Doping, and Stress Effects on Metal-Insulator Transition in Single-Crystalline Vanadium Dioxide Nanobeams

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Vanadium dioxide (VO2) is a strongly correlated oxide exhibiting a first-order metal－insulator transition (MIT) that is accompanied by a structural phase transition from a low temperature monoclinic phase to a high-temperature rutile phase. VO2 has attracted significant attention because of a variety of possible applications based on its ultrafast MIT. Interestingly, the transition nature of VO2 is significantly affected by stress due to doping and/or interaction with a substrate and/or surface tension as well as defects. Accordingly, there have been considerable efforts to understand the influences of such factors on the phase transition and the fundamental mechanisms behind the MIT behavior. Here, we present the influences of oxygen deficiency, hydrogen doping, and substrate-induced stress on MIT phenomena in single-crystalline VO2 nanobeams. Specifically, the work function and the electrical resistance of the VO2 nanobeams change with the compositional variation due to the oxygen-deficiency-related defects. In addition, the VO2 nanobeams during exposure to hydrogen gas exhibit the reduction of transition temperature and the complex phase inhomogenieties arising from both substrate-induced stress and the formation of the hydrogen doping-induced metallic rutile phase.

Keywords: Vanadium dioxide, Single crystalline, metal insulator transition, phase transition

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Ag-modified BiOX (X=Cl, Br and I) Plates for Photocatalytic Dye Removal

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Ag-modified BiOX (X=Cl, Br and I) nanoplates were synthesized by an ion-exchange reaction. We examined the fundamental properties by scanning electron microscopy (SEM), electron transmission microscopy (TEM), X-ray diffraction, UV-visible absorption, Fourier-transform infrared and photoluminescence spectroscopy. The adsorption and photocatalytic performances of the catalysts were tested with dyes under UV and visible light. A chemical scavenger method was employed to test the roles of active species (·OH, ·O2－ and h+) and understand photodegradation mechanism. Photoluminescence spectroscopy was used to examine ·OH radical formation using terephthalic acid during photoirradiation.

Keywords: Ag-modified; BiOX; Adsorption; Photocatalyst; Charge transfer