

Structural and Electrical Properties of VO₂/ZnO Nanostructures

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Abstract : We examined structural and electrical properties of uniformly-oriented VO₂/ZnO nanostructures. VO₂ was deposited on ZnO templates by using a direct current-sputtering deposition. Scanning electron microscope and transmission electron microscope measurements indicated that b-oriented VO₂ were uniformly crystallized on ZnO templates with different lengths. VO₂/ZnO formed nanorods on ZnO nanorods with length longer than 250 nm. X-ray absorption fine structure at V K edge of VO₂/ZnO showed M1 and R phases of VO₂ at 30 and 100 °C, respectively, suggesting structural phase transition between temperatures. Temperature-dependent resistance measurements of VO₂/ZnO nanostructures revealed metal-to-insulator transition at 65 °C and 55 °C during heating and cooling, respectively, regardless of ZnO length. The bond lengths of V-O and V-V pairs in VO₂/ZnO nanorods were somewhat distorted, and a substantial amount of structural disorder existed in the atomic pairs, compared to those of VO₂ films without ZnO. Resistance from VO₂/ZnO nanorods revealed a sharp MIT near 65 °C during heating and a hysteresis behavior. The resistance results suggest that microchannel for charge carriers exist nearly room temperature during cooling. VO₂/ZnO nanorods are quite stable and reproducible so that they can be widely used for practical applications to electronic devices, gas sensors, and ultra-fast switches, as examples.

Keywords : metal-to-insulator transition, VO₂, ZnO, XAFS, structural-phase transition

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