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Growth, structural and electrical properties of VO_2/ZnO nanostructures

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VO_2 is a typical metal-insulator-transition (MIT) material with the bandgap of ~0.7 eV and the Tc of ~ 70°C. VO_2 is transparent and dark below and above the Tc, so that it can be applicable for smart windows by controlling the temperature. VO_2 nanoparticles in a metallic phase block and scatter sunlight. The scattered sunlight by VO_2 nanoparticles can be used in solar cells. We examined the local structural and electrical properties from VO_2/ZnO nanostructures by using the simultaneous measurements of X-ray absorption fine structure (XAFS) and resistance. The structural and electrical properties of VO_2 depend on the length of ZnO nanorods underneath VO_2. Direct comparison of simultaneously-measured resistance and XAFS from the VO_2 demonstrates that the transitions of structures, local density of the V 3d orbital states, and resistance occurred in sequence during heating, whereas the properties changed simultaneously during cooling. XAFS reveals a substantial increase of Debye-Waller factors, particularly, V-V pairs along the {111} direction in the metallic phase. XAFS results indicate that soft phonon above Tc plays a critical role in the collapse of a small band gap of VO_2. The local structural and the electrical properties of VO_2/ZnO nanorods are considerably sensitive to the interface of VO_2/ZnO as well as the length of ZnO nanorods. The interface properties of VO_2 hetero-structures should be considered for its applications to smart windows and solar cells.

Biography

Sang-Wook Han has published over 70 research papers in Solid State Physics, Nanoscience, and Nanotechnology and given over 30 invited lectures. His major research field is the micro-structural and chemical property characterizations of nanomaterials using X-ray absorption fine structure (XAFS) and nanomaterial applications including sensors, battery, and solar cells.

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