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Extended Abstract

Materials Science and Nanotechnology: Synthesis and physical properties of micro-nanostructured V2O5: Structure, optical characterization and sunlight photocatalytic activity - Top Khac Le and Sok Won Kim - University of Ulsan, South Korea

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Abstract

Bulk V2O5 is a diamagnetic semiconductor with a band gap (Eg) of about 2.3 eV, which is based on the ionic configuration with filled O2p and unoccupied V3d orbitals. However, the special electronic structure of V2O5 forms three bands, including V3d states, V3d split-off states and mid-gap states, which lead to interesting optical properties of V2O5 micro-nanostructures. Therefore, the band edge absorption and Photoluminescence (PL) peak positions of low-dimensional V2O5 material are not coincident. In this study, the fabrication processes, structure, optical characterization and photocatalytic activity of V2O5 micronanostructures, including thin films, nanoparticles, micro-nanorods, micro-nanowires, nanospheres, Nanohollows (NHs) and V2O5/RGO nanocomposites were summarized and analyzed. The wide ranges of band edge absorption and broad PL of V2O5 micro-nanostructures are clarified in terms of factors such as the morphology, synthesis method, growth conditions, micronano size and phase transition. The relations among the separation, diffusion, recombination and degradation of the electronhole pairs in V2O5 micro-nanostructures are also studied.

The formation of α-V2O5 films occurred when the sample was annealed at temperatures below 500 °C. As the annealing temperature increases, some of the α-V2O5 structures were distorted and restructured to form a high-quality mixture ofα-β phase V2O5. This leads to wide absorption and enhancement of the visible-light. A larger number of V4+ oxidation states of V2O5 nanospheres strongly enhanced PL intensity compared with other structures that showed weak PL. In particular, V2O5 nanospheres showed intense Ultraviolet (UV) PL near 395 nm (3.14 eV) due to strong excitation by UV light, while this PL peak was not observed from other nanostructures. A large amount of charge separation in V2O5 nanospheres and the large surface contact area in V2O5 nanohollows and nanoparticles result in more efficient photocatalytic activity than from V2O5 micro-nanorods and micro-nanowires.

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