Sputter deposited CuO-WO_3 Nanosized Heterojunctions for Gas Detection

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In this study, we explore the synthesis of nanostructured Metal-Oxide Semiconductor (MOS) system of cupric oxide (CuO NPs) and tungsten oxide (WO_3) films, subsequently utilized as conductometric gas sensors[1],[2]. Nanoparticles of CuO were synthesized using a magnetron-based gas aggregation nanoparticle source (GAN) and deposited on and beneath transparent ultra-thin films of (WO_3). During high-temperature stabilization for gas sensing measurements, interfacial reactions between CuO nanoparticles and WO_3 led to the formation of copper tungstate ($CuWO_4$), creating a multi-component heterostructure [3].

The gas sensing performance of the CuO-WO_3 system was evaluated under varied operational conditions. The composite exhibited enhanced sensitivity, selectivity, and stability compared to individual components, attributed to synergistic interactions at the nanoscale. Key metrics such as response/recovery times and humidity tolerance were systematically analyzed, with optimal samples demonstrating rapid response dynamics and robust performance under humid environments. Selectivity studies revealed preferential sensitivity toward acetone, suggesting tunability for practical applications.

Material characterization via SEM confirmed the uniform distribution of CuO nanoparticles (20–50 nm) embedded within the WO_3 matrix. XRD and Raman spectroscopy validated the coexistence of CuO, WO_3, and $CuWO_4$ phases. The improved sensing mechanism is ascribed to the formation of nanosized heterojunctions at CuO/WO_3 and $CuWO_4/WO_3$ interfaces and charge carrier modulation via $CuWO_4$, which amplifies conductivity changes upon gas adsorption[4]. These findings highlight the potential of engineered heterostructures in advancing gas sensor technology, offering a pathway for designing high-performance, multi-functional sensing platforms through controlled nanoscale integration. Further optimization of composition and interfacial engineering could enable tailored responses for environmental monitoring and industrial safety systems.

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