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Controlled fabrication of nanostructured ZnO gas sensors

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Low temperature hydrothermal synthesis of different ZnO nanostructures with rational control over their morphology and size is important for a wide range of sensing applications. ZnO nanostructures with different dimensionalities have been synthesized through low temperature hydrothermal techniques. One dimensional ZnO NWs have been synthesized with and without the assistance of a seed layer, with a higher degree of control over their structure, morphology, density and dimensions. The large scale production of two dimensional ZnO nanodisks with a high fraction of exposed polar facets have also been produced through using zinc counter ions with preferential capping capabilities on defined facets. Furthermore, using a multistage hydrothermal synthesis, a range of three dimensional hierarchical ZnO nanostructures grown from initial mono-morphological ZnO nanostructures/seeds has been reported. The growth parameters, such as the nutrient concentration, quantity of polyethylenimine, growth time, and zinc counter ions have had a substantial impact on the morphological properties of the grown structures. Gas sensors based on ZnO nanostructures with different dimensionalities have been fabricated and analyzed. The effect of the exposed polar facets on sensing properties of ZnO nanostructures has been investigated and found to play a crucial role in the overall performance of the gas sensors. Ultraviolet activation mechanisms for ZnO gas sensors has been presented and discussed as a substitute to conventional thermal activation. Finally, an effective approach to enhance the performance of ZnO nanostructured gas sensors by using hierarchical structures instead of their mono-morphological counterparts has been demonstrated. Hierarchically ZnO structures display an enhancement of gas sensing performance and exhibit significantly improved sensitivity and fast response to gases in comparison to other mono-morphological ZnO, such as nanoparticles, nanowires, or nanodisks. In addition to the high surface-to-volume ratio due to its small size, the nanowire building blocks show the enhanced gas sensing properties mainly ascribed to the increased proportion of exposed active (0001) planes, and the formation of many nanojunctions at the interface between initial ZnO nanostructure and secondary nanowires.

Biography

Mohammad R Alenezi (PhD, University of Surrey, UK) is an Assistant Professor at the College of Technological Studies in the Public Authority for Applied Education and Training in Kuwait. His research interested in rationally controlled synthesis of metal oxide nanostructures at low temperature and large scale and their uses in the fabrication of different devices for a wide range of applications. In addition to that he is developing piezoelectric nanostructured generators that can supply nano-systems with power. He has published several research papers in different prestigious journals.

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