ZnO AS A BASIS FOR FABRICATION OF NANOCOMPOSITE MATERIALS FOR SENSOR APPLICATIONS

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Zinc oxide is an abundant multifunctional material with unique physical and chemical properties making it suitable for applications in various branches of industry, such as rubber, pharmaceutical, biomedical, cosmetics, agriculture, textile, photocatalysis, electronic and electrotechnology [1]. It provides conditions for the formation of a rich diversity of micro/nanostructure due to the possibility of multiple and switchable growth directions of the wurtzite structure and the high ionicity of its polar surfaces [2], in addition to various nanoparticles [3] and thin films forms [4]. From the point of view of optoelectronic applications, ZnO is an important material for use in blue and ultraviolet optical devices due to its wide bandgap of 3.36 eV at room temperature and large exciton binding energy of 60 meV [5].

This report is focused on the review of two areas of ZnO applications, namely as microstructured sacrificial templates for the preparation of a wide variety of composite nanomaterials and as nanostructured thin films for UV radiation detectors.

Microstructured sacrificial ZnO templates assembled from various microstructures such as microrods, tetrapods or multipods can be produced by different technologies such as chemical bath deposition, hydrothermal synthesis, carbothermal reduction processes, and chemical vapor deposition. Among these technologies, a flame transport synthesis approach for the production of flexible 3D interconnected ZnO networks, based on the direct transformation of metal precursor particles into nano-microstructures of different shapes, proved to feature versatility, simplicity, productivity, and suitability for mass production [6]. Such sacrificial ZnO templates are widely used for the preparation of an ultra-lightweight carbon microtube material called Aerographite (AG) through converting the sacrificial template to graphitic shells in a one-step chemical vapor deposition (CVD) process with toluene or acetylene as carbon source [7]. The AG material has been further used for the preparation of a variety of nanocomposite materials such as AG-GaN, AG-InP, AG-ZnO, AG-CdTe, AG-CdS, etc. The semiconductor nanocrystalline component of these nanocomposites has been grown by hydride vapor phase epitaxy (HVPE) synthesis or magnetron sputtering. The produced nanocomposite materials have been characterized from the point of view of their applications in strain, pressure, photo-, or gas sensors.

The second subject of this report is related to the production and characterization of nanostructured ZnMgO films for UV radiation detectors applications. Alloying of ZnO with MgO ensures a wider range of photodetector wavelength tunability in the UV spectral region (3.4 – 7.8) eV as compared to the GaAlN system (3.4 – 6.0) eV.

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