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Structural, morphological and plasmonic properties of silver decorated zinc oxide nanocomposites prepared by microwave assisted solution phase route

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In recent years metal oxide nanostructures have drawn extensive scientific and technological interest due to their unique electrical, optical, physical, mechanical and magnetic properties, which differ from their bulk counterparts. Among these metal oxides, zinc oxide (ZnO), a remarkable wurtzite n-type semiconductor with a wide direct band gap of 3.37 eV and large exciton binding energy of 60 meV at room temperature, has emerged to be the most promising industrial material due to potential application in photocatalysis, biological and chemical sensors, light-emitting diodes, field-effect transistors, solar cells, lasers, photodiodes, optoelectronics, antibacterial coating and anti-cancer agents owing to its physical and chemical stability, high oxidative capacity, biosafety and biocompatibility.

The modification of zinc oxide with noble metals has attracted significant attention in a variety of applications. Incorporating silver in ZnO is now an exciting area in research for developing electronic applications, enhancing photocatalytic activity, improving optical and plasmonic properties etc. Several methods have been reported to synthesize Ag/ZnO nanocomposites such as chemical bath deposition, sol–gel method, photo reduction method, hydrothermal method, pulsed laser deposition, nonionic polymer assisted thermolysis, and so on. However, most of these methods are limited for research purpose because of high temperature, high pressure, expensive equipments, toxic reagents, or long reaction time. Thus, a simple and fast route for the synthesis of Ag/ZnO is still required to meet economic and industrial needs.

In view of this, present work has been focused to provide a single-step, cost-efective, ultra-fast green synthesis suitable for large scale production of nanocrystalline ZnO, and Ag-doped ZnO for maximizing productivity, minimizing cost and optimizing human effort. The synthesis were based on microwave assisted solution phase route without use of any costly solvents, surfactants, substrates, post-synthesis treatment or hazards ingredients. The synthesized nanocomposites were characterized by high-resolution measurements such as transmission electron microscopy (TEM), scanning electron microscopy (SEM) diffused reflectance spectroscopy (DRS), energy dispersive X-ray spectroscopy (EDX), X-ray diffractrometry (XRD) and Raman spectroscopy. The XRD spectra confirmed that un-doped and Ag-doped ZnO crystallized in a hexagonal wurtzite structure. The TEM results provided average particle sizes of 25 nm to 35 nm (Figure 1). The UV-visible studies showed a blue shift in the band gap energy of doped samples as compared to the un-doped sample. The results were discussed in detail.

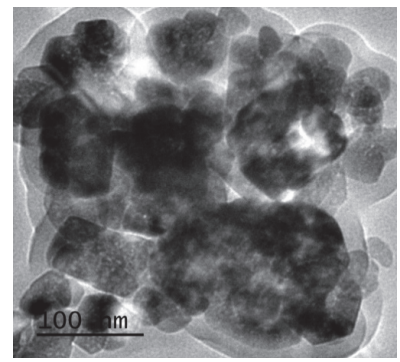

Figure 1: TEM image of ZnO

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