Impact of Synthesis Methods on the Size and Shape of Zinc Oxide Nanostructures

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Zinc oxide (ZnO) has gained a lot of research interest in the present owing to its possibility of usage in various applications such as in solar cells, sensors, photodetectors, photo-catalysts, supercapacitors, and many others. In many of these applications, the size and the shape of the ZnO particles play an important role. This research focuses on facile low-cost synthesis methods of ZnO particles, and how these methods affect the size and shape of the produced particles. The ZnO synthesis was carried out using the chemical precipitation method, followed separately by microwave irradiation, usage of capping agents, and thermal decomposition. The sizes and morphologies of the synthesized samples were assessed using scanning electron microscopy. The microwave irradiation method produced ZnO rods showing a variation in rod size with the length of microwaved time intervals (15 s, 30 s, and 60 s). A relative decrease in the size of the ZnO rods with larger cycle time intervals was observed, the smallest width (~177 nm) being observed for the rods microwaved in 60 s cycle time intervals. The usage of capping agents resulted in ZnO rods, showing a dependence on the capping agent used. The rods synthesized by the usage of Starch and Polyvinyl alcohol (PVA) as capping agents showed axial capping, while those synthesized using Polyethylene glycol (PEG) as the capping agent showed lateral capping. The ZnO particles synthesized using the thermal decomposition method showed a granular shape. The sample synthesized by using Na_2CO_3 as the base showed a noticeably smaller mean particle size of ~75 nm, than those synthesized using NaOH as the base, which showed a mean particle size of ~222 nm. The XRD analysis confirmed that the synthesized particles were ZnO existing in its Wurzite phase. The results show how the size and shape of ZnO nanoparticles can be controlled by manipulating the synthesis conditions.

Keywords: ZnO Particles, Microwave Irradiation, Capping Agents, Thermal Decomposition.

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