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Synthesis of zinc oxide, silver zinc oxide nanostructures and its photocatalytic, antibacterial study

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I have synthesized ZnO nanostructures using solvothermal reaction method at 200 ºC for 48 hours. By modifying the ZnO nanostructures with the polyelectrolytes, I have synthesized Ag – ZnO nanostructures by reducing Ag on polyelectrolyte modified ZnO nanostructures. These synthesized ZnO, Ag – ZnO nanostructures were characterized with various spectroscopic techniques. XRD analysis revealed the formation of crystalline hexagonal ZnO structures, crystalline cubic Ag structures. ZnO nanostructure indicate the UV-Visible peaks at 379 nm and Ag – ZnO nanostructure indicate UV-Visible peaks of ZnO around 390 nm and of Ag in 400-450 nm range. Photoluminescence spectra of ZnO, Ag – ZnO nanostructures have two peaks each. First peak was around 390 nm which is attributed to band edge emission and in both nanostructures second peak is at 500 nm which corresponds to certain defects may be due to Zn or Oxygen ion vacancies. FESEM analysis (Figure 1) of ZnO nanostructures showed formation of hexagonal shaped rod like morphology which has a length in the range of 100 to 400 nm and diameter around 40 nm. FESEM analysis of Ag – ZnO nanostructures showed the formation of rod like structures but the exact morphology of Ag accumulated around the rods is undetermined. TEM analysis (Figure 2) showed the formation of rod like morphology having length around 100 to 400 nm and diameter in the range of 40 nm. Spherical Ag nanoparticles having size 10-15 nm are observed on the surface of ZnO rods. With increase in Ag content the large number of Ag particles covering ZnO rods was observed. Photocatalytic activity of the prepared ZnO, Ag – ZnO nanostructures were evaluated using methylene blue degradation and compared with each other. The Ag – ZnO with 5 wt. % loading has the best photocatalytic activity with rate constant (Kapp) of 10.28 × 10-2 min-1. With the increase of weight percentage (upto some extent) of Ag the photocatalytic activity is increase. As the Ag formed around the ZnO has the high electron affinity, silver catches the electrons and makes them readily available for next reaction by avoiding electron – hole recombination. Antibacterial activities of ZnO, Ag – ZnO nanostructures on gram negative bacteria E.coli were evaluated using Kirby Bauer method. Among all the samples, Ag – ZnO with 10 wt. % loading showed the highest antibacterial activity as the silver content is more, more Ag+ ions are released and these ions play a major role in killing or controlling the growth of bacteria.

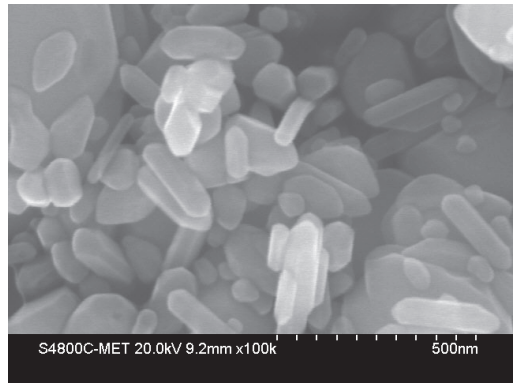

Figure 1: FESEM image of ZnO nanostructures

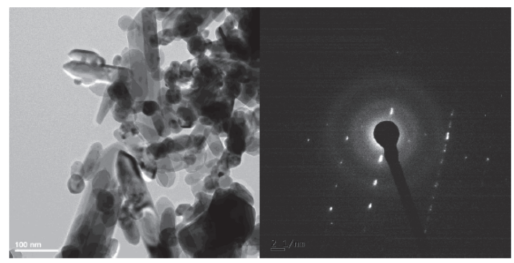

Figure 2: TEM image of Ag-ZnO nanostructures