Highly efficient one dimensional Ag /ZnO nanostructures for photocatalytic applications

Deepak A. Kajale*, R. Marimuthu#, Vikram U. Pandit and Sudhir S. Arbuj

Centre for Materials for Electronics Technology, Off Pashan Road, Panchawati,
 Pune-411008, Maharashtra, India

Email: * deepkajale@gmail.com; # cmetmuthu@gmail.com

Zinc oxide is an important II-VI semiconductor oxide with properties such as, direct band gap of 3.37 eV and large exciton binding energy (60 meV). Due to these unique optical and electrical properties, ZnO has huge application prospects in different optoelectronic and nano devices. Among these applications of ZnO, photocatalysis is the most important for clean energy production and pollution abatement. A considerable effort has been devoted for synthesis of ZnO nanostructures including nanorods, nanowires, nanobelts, nanodisks and hierarchical structures etc. Moreover it is reported that one dimensional nano structures improve the charge carrier mobility which in turn helps to minimize the electron-hole recombination leading to the higher photocatalytic activity. It is reported that the use of co-catalyst enhances the photoactivity of catalyst. In this regard we planned to synthesize the Ag loaded ZnO nanostructures and investigated the influence of Ag on the photocatalytic activity of ZnO.

In the present study, we have synthesized 1D ZnO nano rods using solvothermal reaction technique and the prepared nano rods were decorated with Ag nanoparticles in order to enhance their photocatalytic efficiency. The prepared material is thoroughly characterised and studied the photocatalytic activity towards methylene blue degradation (MB). The Ag nano particles were photo-chemically deposited on ZnO rods with varying molar concentration (0.5 to 10 mol %) and studied the various physico-chemical properties.

XRD analysis of Ag loaded ZnO nanorods revealed the existence of hexagonal phase of ZnO and for higher Ag loaded ZnO nanorods, separate peaks corresponding to metallic Ag appeared (Figure 1). FE-SEM analysis indicates the formation of hexagonal rod like morphology having length around 50 to 200 nm (Figure 2).

The photocatalytic activity of Ag/ZnO was evaluated by following the degradation of methylene blue (MB) dye under 400W mercury vapour lamp (Figure 3).

Figure 1: XRD of Ag/ZnO nanostructures

Figure 2: FESEM of ZnO nanorods

Figure 3: Photocatalytic MB degradation using Ag/ZnO

The ZnO with 10 mol% of Ag loading shows highest photocatalytic activity as compared to 5, 1 & 0.5 mol%. Thus the presence of Ag on the surface of 1D ZnO promotes separation of photogenerated electron-hole pair and enhances photocatalytic activity

References

1. R. Georgekutty, M. K. Seery and S. C. Pillai. *J. Phys. Chem. C*, 2008, *112*, 13563.
2. S. Arbuj, N. Rumale, A. Pokle, J. D. Ambekar, S. B. Rane, U. P. Mulik and D. P. Amalnerkar, *Sci. Adv. Mater.* 2014, *6*, 269-275