Zinc Oxide Nanostructured Cages

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Zinc Oxide has attracted a lot of attention as a wide bandgap semiconducting material due to its amazing electronic and optical properties. As a III–VI wide bandgap semiconductor (3.3eV at room temperature) ZnO has great potential for applications in devices. Some of the current applications for ZnO are as ultraviolet light emitting diodes, ultraviolet filters, gas sensors, surge protectors, and photo diodes. In addition to the current applications of ZnO there is also a great deal of interest in the material as a dilute magnetic semiconductor (DMS). DMS are a new field of materials that involve doping a semiconductor, like ZnO, with a small amount of ferromagnetic atoms. This new field of materials has become extremely popular because of their application in spin electronic devices. Spin electronic devices will likely replace current electronic devices because of their ability to utilize both the charge and spin of an electron allowing them to process and store data simultaneously.

We have produced nanostructured ZnO cages using a low temperature solution based sol-gel technique (see fig. 1). In this technique bulk ZnO is dissolved in nitric acid and added to a dilute solution of citric acid. The solution is then heated for about twelve hour and evaporated creating highly porous ZnO nanostructured cages, colloids, aerogels. Detailed structural and optical characterization of these self-assembled cages were performed using XRD, SEM, EDAX, Photoluminescence (PL) and Raman Spectroscopy. XRD, EDAX and SEM results showed that the ZnO cages are nanostructured and single phase. We also observed quite sharp room temperature photoluminescence signals from these samples. Highly porous nano-cages can be used as gas storage medium for applications in fuel cells as well as in random lasing applications. Using our technique various dopents (Ga, Mn, Co,) can also be introduced into ZnO quite conveniently to tailor its optical, electronic as well as magnetic properties.

Figure 1: SEM image of ZnO cages prepared by sol-gel technique