ZnO Biosensing

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ZnO nanostructures were obtained using two diverse methods: sol-gel and electrosining.

ZnO nanocrystals nad ZnO/MgO core/shell nanocrystals have interesting biological properties (antibacterial, antifungal). ZnO nanocrystals have recently attracted a lot of attention as promising candidates for novel devices, due to a possibility of continuous tuning of optical and electronic properties by varying the particle sizes. They are also of interest for pharmaceutical industry, medicine and/or biology. Obtained nanocrystals were characterized structurally by AFM, TEM , X-ray diffraction and optically by absorption and emission.

We prepared ZnO nanocrystals in colloidal suspensions using a sol-gel method and observed a decrease of the reaction activation energy with an increase in the polarity of the applied solvent. Therefore, the growth rate was higher in a solvent with greater dielectric constant. With increasing nanocrystal sizes the absorption onset was red-shifted. An effective mass approximation model was used to determine the nanocrystal radii. The results were compared with sizes obtained from AFM analysis and a good correlation was found. Depending on conditions and reaction time, we obtained nanocrystals with radii ranging from 2 to 5 nm. Addition of MgO shell resulting in a more intense and stable visible emission that is characteristic of nanocrystalline ZnO. MgO prevents aggregation of ZnO nanoparticles. XRD patterns of powdered ZnO/MgO nanocrystals and TEM data proved wurtzite crystalline structure

Electrospinning is a method capable to produce fibers with diameters ranging from tens of nanometer to microns. Electrospun nanofibrous scaffolds have great potential in several biomedical applications, such as wound dressing, enzyme immobilization, drug delivery, tissue engineering, and they can serve as materials for biosensors. Semiconductor nanofibers are also candidates for applications in electronics and optoelectronics. By adding acetates of other metals, we obtained nanofibers doped with Co, Fe, Al, Mn, Mg. Structural characterization was performed by AFM, SEM, and X-ray diffraction. Additionally, optical characterization was done by cathodoluminescence and photoluminescence measurements at room temperature. XRD investigations proved that the nanofiber material is a wurtzite ZnO. AFM and SEM studies both revealed nanofiber diameters ranging from 100 to 300 nm. Moreover, SEM images of undoped ZnO show that the nanofibers consist of nanocrystallites which diameters from 10 to 50 nm as jointly determined by XRD and SEM . However, metal-doped nanofibers contain significantly smaller nanocrystallites. Moreover, preliminary PL studies of single nanofibers were performed. We observed increased crystal size and investigated the evolution of CL spectra with growing calcination temperatures.

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