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Enhanced Blue Green Emission of ZnO Nanorods Grown by Hydrothermal Method

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Abstract. In this paper, we report enhanced blue green emission of hexagonal shaped ZnO nanorods (NRS) grown via a simple hydrothermal method and silica coated then by using tetraethoxysilane (TEOS). The composition and structural characteristic of the prepared samples were studied by X-ray diffraction (XRD), Field Emission Scanning Electron Microscopy and Energy Dispersive X-ray analysis (FESEM-EDAX). The results revealed well crystallized hexagonal structure possessing a perfect and ideal growth habits of wurtzite zinc oxide grown along the [001] direction in preference in both the cases. Optical properties and quality of the prepared ZnO and silica coated ZnO nanorods were examined by UV-visible and FTIR spectroscopy. Photoluminescence (PL) spectra were used to study ZnO and silica coated ZnO nanorod electronic structure, which resulted in an obvious enhanced blue-green emission for ZnO nanorod and an intense red emission with a very low UV intensity for the silica coated nanorods. Appearance of intense red emission seems to be very promising since and it could favor more reliable fluorescence sensing in drug delivery fluorescent detection with a minor UV emission.

Introduction

The ZnO nanomaterials (e.g., nanorods, nanosheets, nanocrystals) have been employed in optical imaging applications as sum-frequency generation and fluorescence imaging of cells [1-5]. Furthermore, ZnO-based QDs have been reported for fluorescence or dual-modality MRI/fluorescence imaging [6-11]. The major obstacles for biomedical applications of ZnO nanomaterials include low-intensity and short-wavelength luminescence of ZnO, limited capability in the size control of ZnO nanostructures (< 200 nm is preferred for *in vivo* investigations), and sharpness/stiffness of ceramic-based nanostructures (rigid and sharp tips/edges should be avoided to prevent cell/tissue damage). We have already reported a method for synthesis of ZnO nanorods with average particles size diameter of about 20x100 nm at room temperature [12]. Herein, we report synthesis of blue-green fluorescent ZnO nanorods (NRs) which seems to be able to overcome the above cited obstacles and demonstrated the proof-of-principle that ZnO NRs can be specifically targeted to cell surface receptors *in vitro* after coating, which opened up new avenues for future research in tumor-targeted drug delivery.

Experimental details

Materials. Cetyl trimethylammonium bromide (CTAB), $ZnCl_2$, KOH, absolute ethanol, tetraethyleorthosilicate (TEOS) were received from Merck chemical company and used without any further purification. Deionized and distilled water was used for the preparations in this work.