Effect of Dopants on Structural and Optical Properties of Zinc Oxide Nanostructures

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One-dimensional (1D) zinc oxide (ZnO) nanostructures have attracted much interest for the fabrication of nanoscale electronics and optoelectronics devices [1,2]. It has become significantly important to systematically study structural and optical properties of ZnO nanostructures because it requires different physical properties for various device applications [3,4].

We investigated the structural and optical properties of ZnO nanostructures with various Cu and Li doping amounts. Prior to the growth of ZnO nanostructure using chemical solution deposition, ZnO seed layers were prepared on a fluorine-doped tin oxide (FTO)-coated glass substrate by using the sol-gel spin-coating method [5]. Undoped ZnO nanostructures were grown on the ZnO seed layers by using an aqueous solution of zinc acetate dihydrate ($Zn(CH_3COO)_2 \cdot 2H_2O$) and hexamethylenetetramine (HMT) ($C_6H_{12}N_4$). For Cu and Li-doped ZnO nanostructures, copper acetate monohydrate ($Cu(CH_3COO)_2 \cdot H_2O$) and lithium chloride hydrate ($LiCl \cdot xH_2O$) were added as a dopant in the solution, respectively [5].

Within low doping amount, from XRD patterns of the undoped, Cu, and Li doped ZnO nanostructures, it is found that all diffraction peaks belong to the hexagonal wurtzite ZnO phase (JCPDS card No. 36-1451), showing the strongest diffraction peak indexing to the (002) plane. With incorporation of Cu and Li in the ZnO, the length of the nanorods increases compared that of the undoped ZnO nanorods. In the visible region, the optical transmittance of the Li-doped ZnO nanostructures is higher than that of the Cu-doped ZnO nanostructures. With further increasing doping amount, Cu-doped ZnO sample shows notable morphological change from nanorods to microrods, while the Li-doped ZnO nanostructures are kept in the their morphology as the nanorods [5]. Incorporation of various dopants provides a facile approach for tuning the structural and optical properties of ZnO nanostructures.

References

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