Synthesis and optical investigation of ZnO nanocrystals

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Abstract

Well-crystallized ZnO nanoparticles of various sizes (3- 20 nm) were synthesized by different chemical routes without surface modification. The morphology and structure of the nanoparticles were characterized by transmission electron microscopy (TEM), X-ray diffraction (XRD), and Raman spectroscopy. Time resolved photoluminescence (PL) demonstrates that the intensity of ultraviolet (UV) near band edge (NBE) and visible emission bands depend on the size reduction. In addition, the energy of NBE emission shows a clear blue shift as the size of nanoparticles decreases, in agreement with the absorption measurements. The decay time of the NBE exciton is short, while that stemming from intrinsic defects (green emission) is long-lived and exponential. This investigation gives strong indication that a quantum confinement effect exists in the electronic structure of ZnO nanoparticles well above the exciton Bohr radius. The observed size dependence of the UV and green emission intensities opens the possibility of tailoring exciton properties of ZnO nanocrystals for their applications in light emitting diodes or in photovoltaic components.