TEMPERATURE-DEPENDENT PHOTOLUMINESCENCE SPECTRA OF ZnO NANOCRYSTALS

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The mechanism for low-temperature photoluminescence (PL) emissions in ZnO nanocrystals, grown by colloidal route, is studied in detail, using PL spectroscopy as a function of temperature and excitation intensity. In all samples, the PL peak energy as well as the full width at half maximum (FWHM), as a function of temperature, present anomalous behaviors. At sufficiently low excitation intensity and in a narrow temperature interval (50 – 80 K), the samples present two clear competitive PL peaks. The low-energy PL mechanism (8 – 80 K) is dominated by localized PL transitions, while the high-energy PL mechanism is dominated by the ground state PL transition. A modified method was applied to synthesize zinc oxide (ZnO) nanoparticles by addition of lithium hydroxide (LiOH) to an ethanolic zinc acetate solution. This novel approach, employing ultrasound, allows one to produce relatively highly concentrated ZnO colloids. X-ray diffraction (XRD) pattern shows the formation of wurtzite structure. Optical properties of ZnO nanocrystals were measured with UV-VIS. The ZnO nanocrystals morphology has been characterized by the transmission electron microscopy (TEM) with the aim to control the QDs average size. This improved method for the preparation of colloidal ZnO solutions of different particle size is described, and we have obtained different particle sizes by aging. It was found that growing of particle was governed by temperature, the water content, and the presence of reaction products. In this work, depending on the temperature of storage, the ZnO particles grow around 15 days to a diameter of about 7 nm. Other groups add water to the ZnO solution to accelerate the particle growth. It is proven that water plays an important role in the formation of ZnO quantum dots. The advantage of letting the particles grows more slowly at low temperatures (0-10 °C) and without the addition of extra water is twofold. ZnO quantum dots can be obtained with sizes in a range of 3-7 nm.

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