Nanocomposites and nanomaterials

The violet photoluminescence band in ZnO nano-films

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Violet emissions of ZnO have great potential in light emitting and biological fluorescence labeling applications. The violet band (415 nm) was observed in the emission of ZnO films prepared by different methods, but the origins have been controversial for quite a long time. We have carried out the research of the properties of this band in various ZnO-samples to clarify its nature.

The stationary and time-resolved PL spectra of undoped as well as the Cu- and Ag-doped ZnO films deposited by magnetron evaporation on silicon and sapphire substrates at different deposition temperatures were investigated. Doping was performed using the CSS method. The Ag- and Cu-doping was performed by sublimation of the Ag or Cu source located at a close space at the atmospheric pressure in air. The PL was excited by the 337.1-nm pulsed laser and measured at room temperature. The time-resolved PL spectra were recorded with 0.1-ns time delay after the 0.7 ns duration of the sample excitation (life time of the exciton).

The emission spectra of the ZnO films strongly depended on the type of excitation. The stationary PL spectra consisted of two narrow bands at 370 nm (UV), 415 nm (V) and one wide band at 520-600 nm (VS).The time-resolved PL spectra consisted of two narrow bands only. The V-band was observed in all types of films regardless of the type of substrate or the presence of a dopant. The ratio of the intensities of the V-band and the UV band depends on the temperature and duration of heat treatment. It is also shown that the V-band is not associated with the surface states of the films, but is inherent in the entire volume of the film. TheV-band is of a complex nature and consists of 3 sub-bands with the maxima at 408, 415 and 420 nm. The relative contribution of each of the sub-bands is determined by the technological conditions for the film preparation .Analysis of the obtained data allows us to conclude that the V-band is due to the intrinsic defects of the ZnO film and can be attributed to the near band gap emission of ZnO.