Abstract

Er-Tm-Si codoped ZnO (ETSZO) film has been synthesized by co-sputtering. X-ray photoelectron spectroscopy (XPS), Raman spectrum, Transmission electron microscope (TEM) and Electron diffraction pattern (EDP) of this film indicate that Si nanocrystals (Si-NCs) have been formed after annealed at 900℃ for 30 minutes under the N_2 ambient, which can be as broadband sensitizers due to a strong coupling between bond excitons and Er^{3+} or Tm^{3+}. The Er^{3+} and Tm^{3+} related room temperature (RT) photoluminescence (PL) properties show that a fairly flat emission with ~375 nm bandwidth was achieved and enhanced by nearly an order of magnitude by doping Si-NCs. It exhibits broadband emission with relatively stable spectra shape under different excitation lines. The temperature dependence of the PL intensity has also been measured. The 1.80 μm emission increases by a factor of three, meanwhile the 1.53 μm emission keeps almost constant when the operating temperature decreases from 300 to 20 K. Three energy transfer (ET) from Si-NCs to Er^{3+}/Tm^{3+} and from Er^{3+} to Tm^{3+} as well as their back transfer (BT) processes are proposed to explain the emission enhancement and temperature behavior. It should be helpful to understand the interaction among Er^{3+}, Tm^{3+}, and Si-NCs.

Keywords: Er-Tm-Si codoping, ZnO, Broadband emission, Silicon Nanoclusters, Energy transfer.