Synthesis and Spectroscopic Investigations of Cu- and Mn-doped Spherical ZnS Particles

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Monodispersed spherical ZnS particles as well as doping with Cu, Mn were synthesized by a kind of sol-gel procedure from concentrated metal-chelate solutions of ethylenediamine tetra acetate (EDTA) with thioacetamide (TAA). The particles were characterized via TEM, SEM, XRD and luminescence spectroscopy. For the ZnS microspheres, there are two emission sites when excited at 365 nm. The dominative emission site of the green band at 525-540 nm is the self-activated emission, which is red-shifted compared to the blue band at 457-500 nm, which can be assigned to the donor-acceptor pair transition in the ZnS nanoparticles. And the other weak emission site in the ZnS microsphere is at about 420 nm, which is related to the S^{2-} vacancy due to the excess use of TAA solution in the synthesis process. ZnS doped with Cu and Mn have different intrinsic structures due to the difference of the solubility product constant (K_{sp}) of CuS and MnS. The ZnS: Cu particle is a hollow sphere, while the ZnS: Mn particle has a core-shell structure. In addition, we also investigated in detail the dependence of particle size, annealing temperature and concentration of doped ion on the luminescence property of ZnS.