Bifunctional properties of ZnS:0.05Mn nanoparticles

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Abstract

We have successfully investigated the temperature-dependent luminescent and magnetic properties as well as its kinetics of ZnS:0.05Mn synthesized via a chemical co-precipitation route. Both X-Ray and electron diffraction patterns suggest the formation of the cubic zinc blende structure of ZnS with well-defined diffraction peaks and rings, respectively. The high-resolution electron transmission microscope (HRTEM) images show clearly the lattice fringes of ZnS with an average crystallite size of around 4 nm. It is well-established that Mn^{2+}-doped ZnS possesses a blue emission band centered at ca.416 nm and an orange-yellow emission band centered at ca.598 nm whose photoluminescence (PL) intensities depend strongly on the doping level. However, in this study we have found for ZnS:0.05Mn an evolution of such emission bands when ranged from 10 K to 300 K which is consistent with the Mn^{2+} ion relaxation mechanism in ZnS host proposed by Fong for rare earths. Both emission band PL intensities offset at ca.130 K. The luminescence decay of ZnS:0.05Mn was ca.8.9 ms which was found through Förster's model. No temperature dependence of luminescence decay was observed. The Curie's temperature using a superconducting quantum interference device (SQUID) magnetometer was to be approximately 30 K under 300 Oe. The magnetoluminescence properties were further studied and will be also presented.