Nanooptics and photonics

Synthesis and excitation mechanism study of $SrS:Ce^{3+}$ and $SrS:Eu^{2+}$ luminescent nanoparticles

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Luminescent materials find application in lighting (fluorescent lamps, white LEDs) and optoelectronic devices (lasers, waveguides, optical memory, etc.), so development of new materials with improved luminescence characteristics and understanding mechanisms of excitation luminescence are the actual tasks of modern material science and physical chemistry.

Wide band gap metal sulfides are considered as appropriate host for luminescent materials activated by rare earth and transition metal ions because of advantage of relatively low energy of phonons in sulfides [1]. The major known information about doped alkaline-earth sulfides is attributed to bulk materials [1], so this work is focused on study of luminescent properties and excitation mechanism of Ce^{3+} and Eu^{2+} in strontium sulfide nanoparticles.

$SrS:Ce^{3+}$ and $SrS:Eu^{2+}$ nanoparticles were synthesized by single source precursor method by decomposition of $SrDdtc_2$ (Ddtc = diethyldithiocarbamate) with addition of $NH_2Et_2[Ce(Ddtc)_4]$ or $NH_2Et_2[Eu(Ddtc)_4]$ in high boiling point fat amines. To show the success of decomposition of dopant precursors pure Ce_2S_3 and EuS nanoparticles were synthesized in the same synthetic conditions as SrS. The formation of nanoparticles was confirmed by XRD, TEM and DLS analysis.

Spectral characteristics of solid $SrS:Ce^{3+}$ and $SrS:Eu^{2+}$ nanoparticles were studied by methods of photoluminescence, excitation photoluminescence and diffuse reflectance spectroscopy. In luminescence spectra were found broad bands in green and red parts of visible spectrum for Ce^{3+} and Eu^{2+} respectively attributed to $4f^{n-1}5d \rightarrow 4f^n$ transitions. In luminescence excitation spectra of both types of nanoparticles were observed two bands indicated on two different ways of excitation. The low energy bands (~435 nm for Ce^{3+} and ~450nm for Eu^{2+}) were attributed to intrinsic $4f^n \rightarrow 4f^{n-1}5d$ transition. High energy bands at ~250-270 nm may be attributed to SrS band gap transition or to surface organic stabilizer light absorption that evidenced in favor of energy transfer excitation mechanism from nanoparticle to the accepting levels of Ce^{3+} or Eu^{2+}.

1. *Smet Ph. F. et al.* Luminescence in Sulfides: A Rich History and a Bright

Future // Materials–2012.–**3**.–P. 2834-2883.