Thermochemical synthesis of luminescent materials in the Y_2O_3–ZnO system doped with Eu^{3+} ions

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Nanostructured powders of yttrium-zinc oxide doped with europium ion, Y_2O_3–ZnO:Eu^{3+}, were synthesized on the basis of zinc-modified Y_2O_3 matrix (red phosphors) by the method of thermochemical reactions (combustion) using nitrate salts of yttrium, zinc, and europium in the presence of saccharose as a fuel. Y_2O_3–ZnO:Eu powders were thermally treated at 700–1100°C in an oxidizing medium (air). An analysis of the luminescence spectra of the Y_2O_3–ZnO:Eu system led to a conclusion that the emission intensity of the samples under excitation at 467.7 nm largely depends on the treatment temperature of the precursor. The main peak observed under excitation of the phosphor is the luminescence at 611 nm, associated with the supersensitive electric-dipole transition $^5D_0 \rightarrow {}^7F_2$, and the luminescence intensity of the main peak becomes five times higher upon treatment in the range from 700 to 1100°C (Fig.).

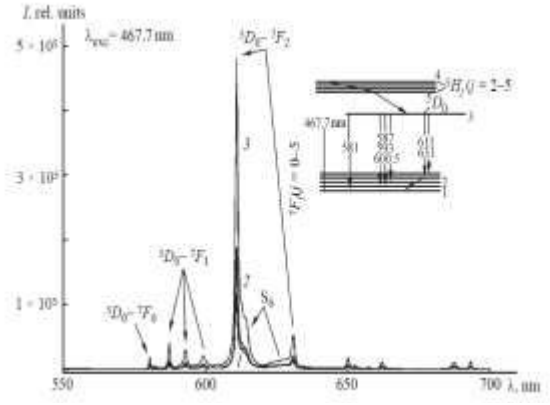

Fig. Luminescent spectra Y_2O_3–ZnO:Eu^{3+}: *1* – 700, *2* – 900, *3* – 1100 °C

An yttrium-zinc oxide ceramic was formed from powders calcined at temperatures of 700, 900, and 1100°C. With Y_2O_3–ZnO:Eu^{3+} powders calcined at 700°C used for compaction of a ceramic, a semitransparent light yellow ceramic is formed with grain size of 2–3 μm, whereas the ceramic obtained by treatment of the precursor powders at temperatures of 900 and 1100°C is less dense and nontransparent and has a grain size of 5–10 μm. The semitransparent ceramic exhibits a photoluminescence emission in the red spectral range at 610 nm under excitation at a wavelength of 468 nm. This composite ceramic may be promising as a material for solid-state photoluminescence converters of the emission from a blue light-emitting diode to the red spectral range and can serve as a basis for red lighting devices (lighting and alarm systems).