Photoluminescent Properties of Nanostructured Y$_2$O$_3$:Eu$^{3+}$ and (Y$_{1-x}$Gd$_x$)$_2$O$_3$:Eu$^{3+}$ Powders Obtained by Aerosol Synthesis

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The nanostructured phosphor particles of Y$_2$O$_3$:Eu$^{3+}$ and (Y$_{1-x}$Gd$_x$)$_2$O$_3$:Eu$^{3+}$ (x=0.25, 0.50, 0.75) systems were synthesized through aerosol method. The corresponding microstructural details were obtained by XRD, SEM, TEM/SAED and HRTEM/FFT methods. Functional properties were examined through photoluminescent analysis. A detailed study of the emission spectra after excitation with 393 nm wavelength and of the decay lifetimes for the as-prepared samples enabled the discovery of improved luminous properties of the obtained powders. The emission spectra showed typical Eu$^{3+}$ 5D$_0$ - 7F$_j$ transitions with dominant red emission at 611 nm, while the lifetime measurements gave an insight into the effect of dopant concentration (5 and 10 at%) on the lifetime distribution into hot lattice according to the applied thermal treatment. Additional improvements in the luminous properties were correlated with the observed structural and morphological features of the synthesized powders.

![Emission Spectra and Decays](image)

The increase in gadolinium content leads to the increase of lattice parameters and consequent peak shift towards lower 2θ angles.

Concentration quenching for 10 at% of Eu$^{3+}$

The increase of diff. value with the increase of Gd content could be treated as a clear indication of almost perfect mixing in solid solutions of (Y$_{1-x}$Gd$_x$)$_2$O$_3$:Eu$^{3+}$ system.

Mixed oxides obtained through spray pyrolysis method have higher lifetimes in comparison to bulk form of pure Y$_2$O$_3$:Eu$^{3+}$ and Gd$_2$O$_3$:Eu$^{3+}$ oxides. For the case of (Y$_{0.25}$Gd$_{0.75}$)$_2$O$_3$:Eu$^{3+}$ with 10 at% of Eu$^{3+}$, strong luminescence quenching is observed resulting in poorer properties even compared to bulk.