Nanocomposites and nanomaterials

The effect of annealing and ytterbium concentrations on the spectral and structure characteristics of $Y_3Al_5O_{12}$ nanopowders

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$Y_3Al_5O_{12}$ (YAG) garnet doped with rare-earth ions have been widely studied owing to its potential applications in the solid state lasers and phosphors. As a rare-earth ion with the simplest energy-level construction, Yb^{3+} ions have some important advantages, in particular, a long radiative lifetime of the upper laser level and no excited-state absorption or upconversion loss compared with other rare-earth ions [1].

The studied YAG nanopowders doped with Yb^{3+} ions have been synthesized by citrate sol-gel method [2]. Activator concentration was equal 5, 10, 15, 20 and 30 at.%. The phase formation of YAG: Yb was characterized by XRD techniques. Anomalous increase of nanopowder lattice parameter with increasing of Yb^{3+} concentration was observed, despite that the Yb^{3+} ionic radius is smaller than that of Y^{3+}. This anomalous concentration dependence, apparently, connected with the presence of Yb^{3+} ions in Al^{3+} positions of the crystal lattice.

The excitation and luminescence spectra, as well as decay kinetics, of YAG:Yb with various doping concentrations were measured at room temperature. Two main excitation peaks are centered at 1016 and 1039 nm, as well as main emission peak, is at about 1030 nm. The Yb^{3+} luminescence intensity, as well as lifetimes related to $^2F_{5/2} \rightarrow {}^2F_{7/2}$ transition, decreases with increasing concentration from 5 to 30 at. %. An enhanced photoluminescence emission and the better spectral resolution were observed in samples with a high degree of crystallinity. The results of the influence of annealing temperature on the structural and luminescence characteristics are also presented.

1. *Xu X., Zhao Z., Song P., et al.* Journal of the Optical Society of America B.-2004.- **21, N** 3.-P. 543-547.
2. *Zhydachevskii Ya., Syvorotka I.I., Vasylechko L., Sugak D., et al.* Optical Materials.-2012.-**34.**-P. 1984–1989.