GROWTH AND LUMINESCENT PROPERTIES OF $Y_3Al_5O_{12}$:Mn SINGLE CRYSTALLINE FILMS

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Mn-doped Y-Al- garnets and perovskites can be considered now as perspective storage and thermoluminescent materials, as well as the materials for holographic recording (Zhydachevskii et al., 2004, 2006). That stimulates us to study the luminescence properties of manganese in single crystalline films of $Y_3Al_5O_{12}$ (YAG) garnet grown by liquid phase epitaxy method from supercooling melt-solution based on PbO-B_2O_3 flux onto YAG substrates. The concentration of MnO_2 activating oxide in melt-solution was varied in the 0.1-10 mole % range, and the Mn concentration in YAG SCF was changed in 0.002-0.19 at % range.

In this work we compare the luminescent properties of YAG:Mn with their single crystal analogues grown from the melt by the Czochralski method [1, 2]. The special goal was spectroscopic determination of the preferable valence states of manganese ions which is realized in the SCF. The absorption and emission spectra of YAG:Mn SCF testify that the main valence state of manganese ions in these films is Mn^{3+} state. In YAG:Mn SCF the small amount of Mn^{4+} and Mn^{2+} ions was also found, that were caused mainly by the Pb^{2+} (from flux) and Pt^{4+} (from crucible) incorporation in SCF and the possibility of charge compensation of Mn^{4+} and Mn^{2+} ions by substitution of Pb^{2+} and Pt^{4+} ions, respectively.

Studying the energy transfer to the different states of manganese ions in YAG host has been performed using the time-resolved luminescent spectroscopy of YAG:Mn SCF under excitation by pulsed (0.127 ns) synchrotron radiation with an energy of 3.7-25 eV at Superlumi experimental station (HASYLAB at DESY) at 8 and 300 K. We show that the Mn^{2+}, Mn^{3+} and Mn^{4+} luminescence YAG and YAP can by effectively excited both in the exciton range (6.8-7.8 eV) and in the onset of the interband transition (7.8-8.5 eV) as well as in the range of $O^{2+} \rightarrow Mn^{n+}$ (n=2, 3, 4) charge transfer transition in the 200-280 nm range. The scheme of high-energy levels of different states of manganese ions YAG host can be defined more exactly based on the obtained results.

References

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