Proceedings of the 2nd World Congress on New Technologies (NewTech'16)
Budapest, Hungary – August 18 – 19, 2016
Paper No. ICNFA 141
DOI: 10.11159/icnfa16.141

Morphology And Luminescence Characteristics of Yttriumdisilicate Doped with Yb^{3+}, Er^{3+}(Ho^{3+}) and Tm^{3+}

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Extended Abstract

The nanomaterials doped with optically active ions have attracted considerable attention, and most of the studies in the literature devoted to the fabrication and characterization of these materials due to their potential application in photonics and optoelectronics. This interest on such host materials steadily increased with the development of new and cheap synthetic methods. [1-3].

The host lattice of yttrium silicate (SiO_2–Y_2O_3 binary system) shows a high refractory property, chemical stability. The host lattice of yttriumdisilicate ($Y_2Si_2O_7$) shows a high thermal and chemical stability. It has been shown that the structural phases due to its complex high temperature polymorphism are in the **y**, z, **α**, **β**, **γ**, and **δ** forms [4-7]. In this study, RE^{3+}:$Y_2Si_2O_7$ nanopowders were synthesized in the phase diagram of SiO_2-Y_2O_3 binary system using the sol–gel method to obtain alpha phases.

The $Y_2Si_2O_7$ activated with triple RE^{3+}: (Yb^{3+}:Er^{3+}: Tm^{3+} and Yb^{3+}: Ho^{3+}: Tm^{3+}) was successfully synthesized using the sol–gel technique. The diffuse reflections spectra of the triple doped $Y_2Si_2O_7$ samples in the range of 400-1050 nm were taken. The absorption bands appearing with appreciable intensity correspond to transitions from the ground state of the RE^{3+} ions to different excited states of them.

Up-converted green and red emissions were obtained in visible region from Yb^{3+}:Er^{3+} (Ho^{3+}):Tm^{3+} doped $Y_2Si_2O_7$ nanopowders on excitation by a 950 nm diode laser. In the Yb^{3+}:Er^{3+}:Tm^{3+} doped $Y_2Si_2O_7$ nanopowders, the green emissions around 525 nm and 547 nm were attributed to the $^2H_{11/2} \rightarrow {}^4I_{15/2}$ and $^4S_{3/2} \rightarrow {}^4I_{15/2}$ transitions of the Er^{3+} ions, respectively. The strong red emission around 663 nm and 692 nm were attributed to the $^4F_{9/2} \rightarrow {}^4I_{15/2}$ transition of Er^{3+} ions and the $^3F_{2,3} \rightarrow {}^3H_6$ transition of Tm^{3+} respectively. In the Yb^{3+}:Er^{3+}:Ho^{3+} doped $Y_2Si_2O_7$ nanopowders, the green emissions around 530 and 560 nm were attributed to the $^5F_4 \rightarrow {}^5I_8$ and $^5S_2 \rightarrow {}^5I_8$ transitions of the Ho^{3+} ions, respectively. The red emission around 670 nm was attributed to the $^5F_5 \rightarrow {}^5I_8$ transition of Ho^{3+} ions and $^3F_{2,3} \rightarrow {}^3H_6$ transition of Tm^{3+} ions. The near infrared emission around 800 nm was also attributed to $^3H_4 \rightarrow {}^3H_6$ transition of Tm^{3+} ions.

In order to understand the up conversion mechanisms of the observed emission bands, the up conversion emission intensity was measured as a function of excitation power. The calculated results indicated that slopes value of triple doped α-$Y_2Si_2O_7$ nanoparticles showed that the up conversion mechanism corresponding to green and red emissions occurred via two-photon transitions.

Acknowledgement

This work was supported by the research Grants of Marmara University (Grant No. FEN-D-100616-0285).

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