Preparation and spectral properties of Er, Yb and Li doped glass microspheres with YAG composition

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Er^{3+} ion aroused interest in laser technique for its ability emit radiation at excitations ultraviolet, visible, and infrared radiation. This ion emits green radiation with waves lengths 525-567 nm, red radiation with waves lengths of 625-725 nm and infrared radiation with wavelets lengths of 1450-1650 nm. More recently Yb^{3+} and Li^{+} ions have been used as sensitizers to strength intensity emissions. Yttrium-aluminum garnet $Y_3Al_5O_{12}$ (YAG) is frequently used as matrix in construction of solid-state lasers especially for applications which needs high hardness, thermal and chemical resistance. YAG can be used in both monocrystalline and polycrystalline form. The disadvantage of this material is financially and technically difficult preparation which requires high temperatures and long times. Aluminate glasses (AG) seems to be full-fledged substitute for this material due to their comparable mechanical and optical properties and mainly due to their ability to bind much higher concentrations of optically active elements into the structure. The disadvantage of AG is the complexity of their preparation, which requires high melting temperatures and high cooling rates. Flame synthesis (FS) of AG is potentially appropriate method on the preparation from an economic and technical point of view.

This work is focused on the preparation of glass microspheres with YAG compositions (62.6 mol.% Al_2O_3 and 37.4mol.% Y_2O_3) doped by different concentration of Er^{3+}, Yb^{3+} and Li^{+} ions. Pechini sol-gel methods was used for starting powders preparation to ensure homogeneous distributions of dopants in the entire volume of glass. FS with methane-oxygen flame was used for preparation of glassy powders. X-ray patterns shown predominantly amorphous character of prepared glasses with presence of small amount of YAG phase. Thermal analysis of microspheres revealed one exothermic effect with maxima in interval 916-930 °C. Interest finding is a shift of crystallization effect to higher temperatures with addition of Li^{+} ion. Fluorescent emission spectra, measured at 378 nm shown characteristic emissions band in green and red areas, which could be attributed to $^2H_{11/2} \rightarrow {}^4I_{15/2}$,$^4S_{3/2} \rightarrow {}^4I_{15/5}$ and $^4F_{9/2} \rightarrow {}^4I_{15/5}$ transitions. From the result, it can be concluded that the investigated systems are suitable candidates for the preparation of luminophores producing pure green light. The highest intensity of this light was obtained in sample with addition 0.75 mol.% of Er^{3+} and 8.00 mol.% of Li^{+} ion.

Acknowledgement

The Slovak Research and Development Agency supported this work under contract No. APVV-17-0049, APVV-19-0010 and by grant VEGA 1/0476/22. This paper is a part of the dissemination activities of the project FunGlass.
This project has received funding from the European Union´s Horizon 2020 research and innovation programme under grant agreement No 739566.