Optical characterization of Eu^{3+}-doped $LiLa(WO_4)_2$ single-crystal fibers grown by micro pulling down method

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Compounds of the family $A(RE)(WO_4)_2$ where A = Li, Na and RE = rare earth as Y, Gd and La, crystallize in the scheelite-like ($CaWO_4$) structure, exhibit good thermal and chemical stability, and therefore are considered to be good host materials for rare earth ions to design luminescent materials. In the last years investigations on this tungstates compound family were concentrated on bulk single crystals; more recently they are also been studied as single crystal fibers. In addition to the well know materials laser properties, single crystal fibers are also interesting because of their reduced cost of preparation and potential for nonlinear optical devices. The fiber shape is suitable to nonlinear optical interactions, whose efficiencies can be greatly enhanced by the long interaction lengths and tight beam confinement available in guided wave structures.

In this work we report the investigation of single crystal fibers growth and optical characterization of Eu^{3+}-doped $LiLa(WO_4)_2$ (LLW:Eu). The starting compound was obtained by solid state reaction from commercial reagents (Li_2CO_3, La_2O_3, Eu_2O_3 and WO_3). The mixture was heated at 750°C for 48h in a rate of 50°C/h and cooled down in the same rate. The formation of the LLW:Eu phase was confirmed through x-ray diffraction analysis.

Single crystal fibers were growth by the micro-pulling down method (mPD) in a resistive heating mode with pulling rates of 0.06 mm/min, in air atmosphere, and platinum-gold crucibles. Transparent and uniform single crystal fibers with 10mm length were obtained.

We use site-selective excitation spectroscopy to investigate substitution sites for Eu^{3+} and defect structures of the Eu-doped LLW crystals. The narrow excitation and emission lines due to the $4f \rightarrow 4f$ transitions of Eu^{3+} in LLW offer an appropriate method for monitoring the different sites. Each line appearing in the excitation spectra of the $^7F_0 \rightarrow {}^5D_0$ transition corresponds to a different Eu^{3+} center since the transition between the nondegenerate $^7F_0$ and $^5D_0$ levels can have only one line per site. By our results we conclude that the Eu^{3+} ions occupy at least two different sites in $LiLa(WO_4)_2:Eu^{3+}$ crystal.

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