Growth and characterization of pure, Nd^{3+} and Yb^{3+}-doped $LiLa(WO_4)_2$ single-crystalline fibers by the micro-pulling-down method

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Abstract

The production of single-crystalline fibers has been presented in the last years as an interesting tool in the investigation of optical and structural properties of many materials. Additionally, the growth of single-crystalline fibers is faster and relatively low-cost when compared to traditional bulk crystal growth methods. Studies about rare earth doped $LiLa(WO_4)_2$ (LLW) bulk single crystals were reported recently showing that this material reveals itself as a promising solid state laser material in the near-IR range [1-2]. In this work we report the investigation of single crystal fibers growth of pure and Nd^{3+} and Yb^{3+}-doped LLW for optical applications.

The starting compound was obtained by solid state reaction. The samples were analyzed by x-ray diffraction and thermal analysis. The experimental results showed that moisture on stored La_2O_3 is an issue to be controlled to achieve a single phase formation after the solid state reactions.

Single crystal fibers were grown by the micro-pulling down method (mPD) in a resistive heating mode and the growth process was investigated concerning the melting behavior, pulling rates and the meniscus stability during the fiber pulling. The fibers were prepared with pulling rates from 0.05 to 0.35 mm/min, in air atmosphere. Evaporation was noted on the pure and doped LLW fibers growth. A white film deposition upward the growth chamber was observable during the growth process. Stable growth conditions were obtained for meniscus height changing from 60 to 150 microns. It is important to note that higher meniscus heights break the stable condition of growth resulting in defects creation in these fibers. Transparent and uniform single crystal fibers with 30mm length (LLW and LLW:Nd) and 10mm length (LLW:Yb) were obtained. Optical characterization demonstrated similar properties observed on bulk crystals of Nd and Yb-doped LLW.

References:

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