

Yb:Er-doped LiLa(WO₄)₂ single crystal fiber growth

R. L. Denaldi, S. L. Baldochi, L. Gomes, V. L. Mazzocchi, J. R. Moraes, C.B.R. Parente.
Instituto de Pesquisas Energéticas e Nucleares, São Paulo, Brazil

Rare earth doped tungstate single crystals have early gained attention because of their suitable properties for laser media application. However, many of the tungstate compounds have a phase transitions, mainly the ones based on potassium ions (as KYW and KGdW) and they cannot be grown directly from their melt. The LiLa(WO₄)₂ compound is among the tungstate crystals that have a relatively low melting point (1065 °C), and no phase transitions upon cooling. Their growth, doped with rare earth ions, was reported by Czochraslki and micro-pulling-down method. Single crystal fibers are attested as a low cost and reduced dimension alternative for laser devices [1] and an ideal method for crystallization studies. In this work, we investigate the growth process of Yb³⁺/Er³⁺:LiLa(WO₄)₂ single crystal fibers. The material's synthesis and the effect of different dopant concentrations on the melting properties were studied by thermal analysis, x-ray diffraction and Rietveld analysis aiming to optimize the crystal growth. Fibers were characterized by x-rays diffraction and absorption and emission spectroscopy.

The starting materials LiLa(WO₄)₂ (LLW) and LiYb(WO₄)₂ (LYbW) were previously synthesized by the solid-state reaction method. The appropriate mixtures were weighted directly on the DTA crucibles for thermal analysis. Runs were performed under air atmosphere with heating/cooling rates of 5°C/min. Experimental X-ray powder diffraction patterns were measured at room temperature in the 10° to 100° range. The Rietveld method was used to analyze the obtained phases using the General Structure Analysis System (GSAS) program. Fibers were prepared in a resistive micro-pulling down furnace. The obtained DTA curves are in agreement with previous study of Li₂W₂O₇ – La₂W₂O₉ phase diagram for the compound LLW [2]. The addition of Yb modified the melting behavior of this compound as can be noted on Fig. (1a). LiLa_(1-x)Yb_(x)(WO₄)₂ fibers with 1 mm in diameter and 10mm long were prepared with fixed Er concentration (0.5 mol%) and variable Yb concentration (x = 1, 2, 5 and 10 mol%) (see Fig.1b). The observed results will be discussed.

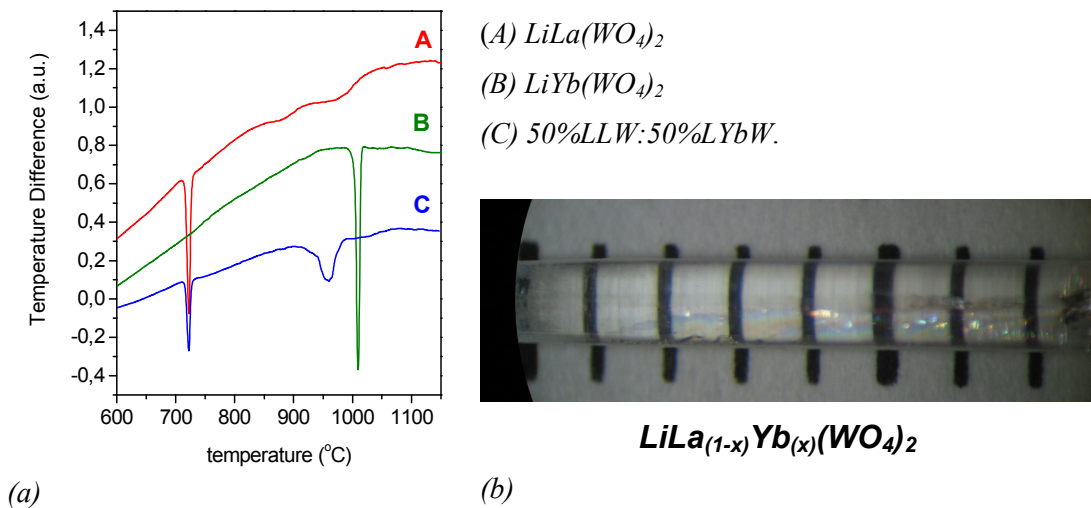


Fig. 1(a): DTA curves: (A) LLW; (B) LYbW and (C) 50%LLW:50%LYbW. (b) Single crystal fiber of LiLa_(1-x)Yb_(x)(WO₄)₂ grown by micro pulling down method.

[1] L. Deyra, I. Martial, J. Didierjean, F. Balembois, P. Georges, *Optics Letters*, **38**, 3013 (2013).

[2] J.R. deMoraes, D. Klimm, V.L. Mazzocchi, C.B. Parente, S. Ganschow, S.L. Baldochi, *Crystal Growth & Design*, **14**, 5593(2014).

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