Crystal growth of pure and Nd^{3+}, Yb^{3+}-doped $NaLa(WO_4)_2$ and $LiLa(WO_4)_2$ single fibers

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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. The growth of single crystalline fibers is fast and relatively low-cost compared to traditional bulk crystal growth from the melt. Additionally, their unique properties point to their use for production of a variety of optical and electronic devices, as for example, compact solid state lasers.

Several works were reported on the properties of alkali rare earth tungstates $A(RE)(WO_4)_2$, where A= K, Na, Li; and (RE) = rare earth elements. However, very little investigations were performed on single crystal fiber growth of tungstates. In fact, only one report was found on fiber growth of $NaGd(WO_4)_2$ (NGW)[1].

In this work we report the preparation of pure and Nd^{3+} ,Yb^{3+}- doped single crystal fibers of $NaLa(WO_4)_2$ (NLW) and $LiLa(WO_4)_2$ (LLW) . The compounds were prepared by solid state reaction from Na_2CO_3, Li_2CO_3, La_2O_3 and WO_3, respectively; and the growth process was performed by micro-pulling down method (µPD) [2]. Fibers were growth with pulling rates of 0.2 – 0.5 mm/min in Pt crucibles. The characterizations were performed by x-ray diffraction, microscopy, thermal analysis and absorption spectroscopy.

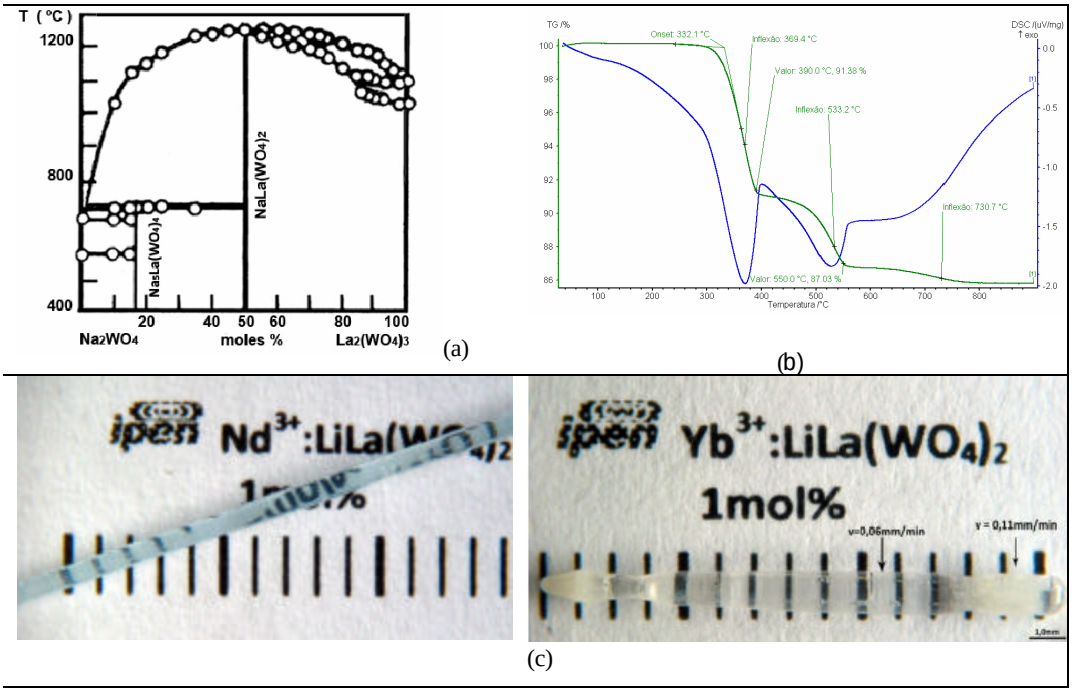

Figure 1. (a) Phase diagram [3]; (b) La_2O_3 DSC/TG curve; (c) as-grown fibers.

The water adsorption of La_2O_3 compound from environment can became a huge problem on the synthesis of these materials. However, the Neodymium and Ytterbium doping (1-2mol%) showed no significant changes on the solid state reactions. Higher evaporation was observed on NLW when compared to LLW fibers growth. Further, the capillary stability (uniform diameter), was much more difficult to control in the case of NLW fiber growth. The mainly reason is the higher melting temperature of this compound which is very close to the limit of the resistive µPD equipment used. It was also observed that the substitution of the La^{3+} by Yb^{3+} resulted in the increase of evaporation of the melt compound. Despite of the observed problems single crystal fibers of pure and Nd and Yb doped LLW and NLW (figure 1) were obtained and characterized concerning structural and optical properties.

References:

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[3] Y. Rode, V.N. Karpov, M.M. Ivanova. Rus.J. Inorg. Chem. 16 (1971) 905-908.