

Crystal growth and characterization of $(\text{Gd,Y})_{1-x}\text{La}_x\text{VO}_4$ single crystal fibers prepared by the LHPG technique

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Among all the materials suitable to be used as the active element in this type of lasers, the vanadate single crystals are of fundamental importance, due to the possibility to obtain lasers system with low threshold and high slope performance. However, the difficulties involved in the growth of high quality REVO_4 ($\text{RE}=\text{Y, Gd}$) single crystals are limiting the scale production of these compact solid state lasers. The major problem in the growth process of such crystals lies in the valence change of vanadium ions, from V^{+5} to V^{+4} or even V^{+3} . This is pointed out as the cause of the black color or black inclusions inside the grown crystals. Improvements have been made in the growth process of bulk crystals in the presence of O_2 controlled atmosphere, but the time and cost still inappropriate. We describe in this work the growth of pure and Nd^{3+} doped transparent fibers of $\text{RE}_{1-x}\text{La}_x\text{VO}_4$ ($\text{RE} = \text{Gd, Y}$ and $x= 0.2, 0.4$ and 1.0) by the Laser Heated Pedestal Growth technique in air atmosphere. The fibers obtained were in the range of 400 to $700 \mu\text{m}$ in diameter and up to 40 mm in length. Our crystalline fibers were free of black phases and microscopic inclusions. Temperature measurements on the molten zone surface showed that the liquid temperature suddenly dropped approximately $200 \text{ }^\circ\text{C}$. This decrease in the liquid temperature is here associated with a self-adjustment of the melt composition during the fiber growth. Crystallographic data shows that the obtained fibers ($x= 0.2$ and 0.4) belong to the $\text{I4}_1/\text{amd}$ symmetry, with the exception of LaVO_4 ($x=1.0$), which crystallized with $\text{P2}_1/\text{n}$ symmetry. Optical absorption and lifetime measurements on Nd^{3+} doped fibers showed the same good optical properties as the Nd:YVO_4 bulk crystals, with larger spectral linewidths which are desired for diode laser pumping.

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