Micro-pulling-down grown Tm,Ho:GSAG crystal as laser gain medium

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Gadolinium-scandium-aluminium garnet (GSAG) is a relatively less-known crystal, primarily studied for scintillator applications [1]. While GSAG has been used as a laser host matrix doped with neodymium or erbium ions [2,3], only a few reports exist on thulium and holmium doping for laser emission around 2-2.1 µm [4], making this a still largely unexplored area. Lasers operating around this wavelength range are highly relevant for free-space optical communication, LIDAR, environmental gas sensing (e.g., CO_2 and H_2O detection), medical applications, and pumping of mid-infrared optical parametric oscillators.

Traditionally, GSAG crystals are grown by the Czochralski method, which, although effective, can be time-consuming and resource-intensive. Alternatively, the micro-pulling-down (µ-PD) method offers a cost-effective approach to crystal growth. This method enables rapid crystal growth with minimal basic material consumption, which reduces costs and facilitates fast screening of different material compositions [5].

In this work, we explored a Tm,Ho co-doped GSAG crystal grown by the µ-PD method as active laser medium for generation around the wavelength of 2.1 µm. We investigated laser performance under pulsed excitation at both 0.8 µm and 1.7 µm, as well as continuous-wave excitation at 1.7 µm. Special attention was given to the tunability of the laser emission wavelength. Successful laser generation was achieved with slope efficiency reaching up to 30%, and a wavelength tuning range up to 138 nm. Our results demonstrate that µ-PD grown Tm,Ho:GSAG crystal represents a promising gain medium for widely tunable 2.1 µm lasers, highlighting the advantages of the µ-PD growth method for efficient and economical laser crystal fabrication.

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