

Laser Action in Nd:LiYF₄ Single Crystal Fiber

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Laser action in monocrystalline fibers has been reported recently in frequently used active laser media such as Nd:YAG and Nd:YVO₄, demonstrating the advantages of this kind of active media. Single crystal fibers (SCF) can be pulled much easier and faster than bulk crystals, using less material; Micro-pulling-down and Laser-heated pedestal growth are the most used techniques for fiber production. As an active medium, SCFs combine the advantages of bulk crystals like high emission cross-sections, spectroscopic and unique thermo-mechanical characteristics with fiber form advantages, mainly the elevated heat removal capacity due to a high surface to volume ratio of the fiber. Also fibers can be produced with low doping concentration and long lengths diluting the pump absorption due to a better pump overlap.

This work presents a Nd:LiYF₄ single crystal fiber laser and its characterization. A small plane-concave cavity was mounted with a 1 cm long fiber and output coupling of 5%. This fiber was pumped by a 40 W diode laser bar with beam shaping optics.

As a result 13 mW of average output power were extracted from this resonator when working with 2 ms pulse duration and a duty cycle of 6.5%. A slope efficiency of 6.1%, corresponding to 5.4% of optical-to-optical efficiency, was achieved. For the best of our knowledge, this is the first single crystal Nd:YLiF₄ fluoride fiber laser.