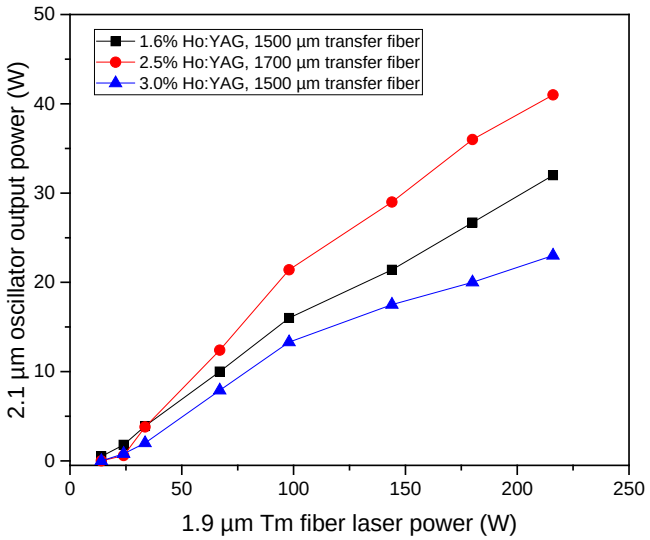
Recent Work on Ho:YAG Thin Disk Lasers in the multiple 10 W Range

G. Renz and J. Speiser

German Aerospace Center, Institute for Technical Physics, Pfaffenwaldring 38, Stuttgart, Germany

Continuous wave and pulsed lasers in the 2 µm - range show applications in laser material processing, medical treatment, wind LIDAR and mid-infrared continuum generation.

Scaling Ho:YAG thin disk lasers into the multiple 10 Watt range has been demonstrated [1,2]. One of the main challenges of recent work is the suppression of the occurrence of higher order modes starting at the lower Watt level range. In Figure 1 (left) the output power of a cw oscillator is shown for different Ho^{3+}-concentrations pumped with three 120 W Tm fiber lasers through a single transfer fiber into the thin disk module. The picture on the right side shows the temperature profile on the disk with a pump beam diameter of 4 mm and an oscillator output power of roughly 10 Watt. An inhomogeneous temperature profile with single peaks are recognized which are interacting with the multimode laser field. Even using the advantage of the thin disk cooling, the occurrence of the temperature peaks can be explained by a self-focusing effect starting from the multiple pump thin disk principle and the low output coefficient of roughly 1% in the resonator. The occurrence of turbulence in the resonator volume and with it the change of the multimode structure in the time scale of sub-seconds can be seen in the thermal and laser mode pictures which emphasize a minor influence on the generation of higher order modes.



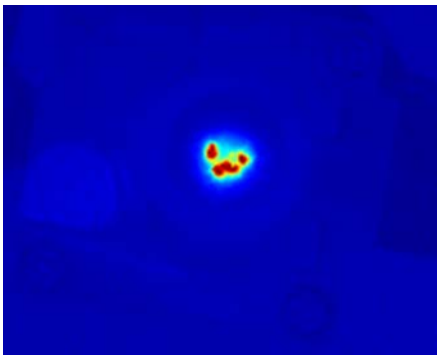


Figure 1. Left: cw output power for different Ho^{3+}- concentrations. Right: Temperature profile on a 3% at. Ho:YAG soldered thin disk with a thickness of 300 µm at a multimode laser output power of roughly 10 Watt from the resonator.

[1] G. Renz, et al., "2 µm Ho:YAG Thin Disk Laser", ASSP, OSA, paper AWA24 (2011).

[2] J. Zhang, et al., "High–Power, High-Efficiency Tm:YAG and Ho:YAG Thin-Disk Lasers", Laser Photonics Review (2018).