

937 W Thulium:silica fiber MOPA operating at 2036 nm

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Recent advances in high-power thulium-doped fiber lasers make them an attractive solution for applications in the 2 μm region, such as LIDAR, remote sensing, or defense applications. All these applications take advantage of a high transmission window in the atmosphere [1]. Output power greater than a kW have been demonstrated twice [2,3]. However, the rarity of similar results shows how challenging the power scaling of thulium-doped fiber lasers with output power greater than 600 W is, with primary constraints being heat management or thermal mode instability (TMI).

In this work, we present our latest results in power scaling in the 2 μm region. In order to maintain a stable atmospheric transmission a MOPA configuration is chosen instead of a single-oscillator configuration as it allows maintaining the wavelength over a wide range of output powers [4]. The MOPA configuration relies on a simple setup, consisting of a seed laser followed by a single-stage high-power amplifier. No isolator is used between the seed and the amplifier stage and operation relies only on the saturation of the amplifier by the seed laser. The seed laser is a monolithic thulium-doped fiber laser cavity based on fiber Bragg gratings. It delivers 10 W at 2036 nm with a linewidth of 0.1 nm at full-width half-maximum. The amplifier relies on a 25/400 thulium-doped fiber co-pumped by 793 nm multimode diodes. The setup is all-fiber spliced to allow for an efficient and robust design.

The graph on the left side of Figure 1 shows the output power versus pump power. The output power evolves linearly with the pump power and leads to a slope efficiency of 57.7 %. A maximum output power of 937 W was reached for a pump power of 1636 W. For the maximum output power this leads to an electric-to-optical efficiency of 24 %. The beam quality was measured over the whole pump power range and is plotted on the right hand side of Figure 1. The M^2 is close to diffraction limited, with values below 1.3. No TMI or other non-linear effects were observed up to the maximum output power.

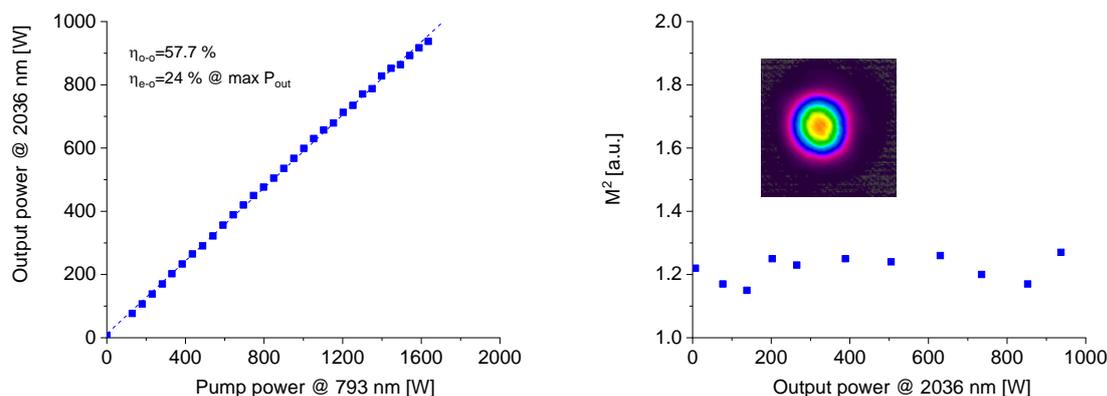


Figure 1: MOPA laser output power versus 793 nm pump power at an emission wavelength of 2036 nm.

This performance thereby demonstrates the readiness of the thulium-doped fiber laser technology for high-power applications. Operation of the MOPA was pump power limited; thus, further power scaling would be possible with brighter pump diodes as the TMI threshold is expected to be above 1 kW.

References

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