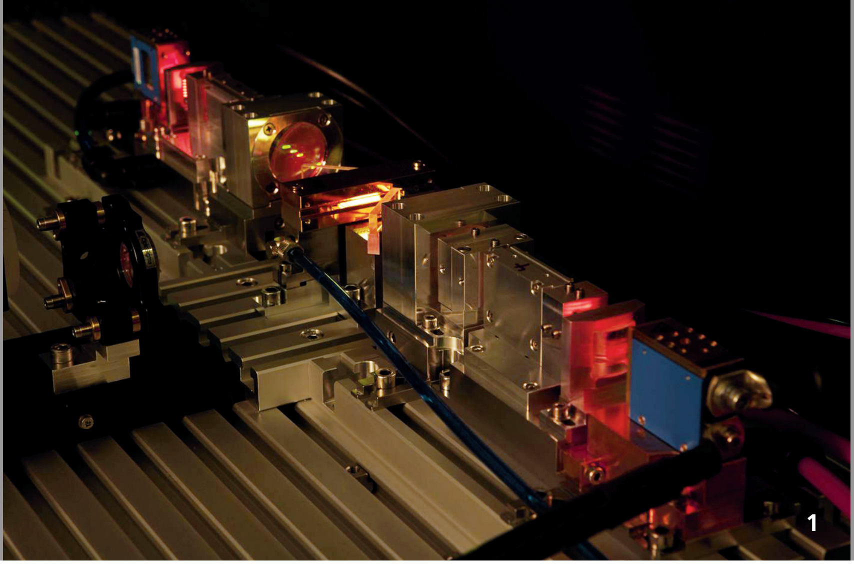

TM:YLF INNOSLAB LASER WITH 200 W AT 2 µM

Task

The wavelength region around 2 µm supports a variety of applications ranging from medical applications and trace gas detection in the atmosphere to processing VIS-transparent materials. A system with Thulium (Tm) and Holmium (Ho) as laser-active ions in solid-state crystals is well established as an efficient way to generate laser radiation at 2 µm. Tm-doped materials are well suited as active materials in cw laser beam sources and can be diode-pumped directly at 800 nm. Ho-doped solids are also suitable for energy storage operation and can be pumped using Tm based lasers. The INNOSLAB concept is ideal for implementing the diode laser/Tm laser (cw)/Ho laser (pulsed) chain for large optical output powers above 100 W. The aim of the work is to study the entire chain and provide amplifiers with high average output power for scaling commercial lasers in the region of 2 µm.

Method

A Tm:YLF INNOSLAB crystal is pumped partially from both ends using diode laser stacks at 792 nm. The produced gain volume with a rectangular cross-section and large aspect ratio is incorporated in a stable resonator whose Gaussian fundamental mode in the narrow axis is adjusted to the height of the gain volume and operated in high multimode ($M^2 > 100$) in the wide axis. This produces a homogeneous top-hat-shaped beam distribution that is particularly suited to pumping a Ho-doped laser crystal with an INNOSLAB geometry.

Result

An optical cw output power of 200 W with a wavelength of 1.9 µm is achieved from an absorbed pump power of 490 W. The optical efficiency in relation to the absorbed pump power is 40 percent; the slope efficiency is 50 percent. The efficiency is currently limited by the damage threshold of the mirror coatings used; other coatings are being investigated.

Applications

Apart from use as a pump source for Ho-based INNOSLAB amplifiers around 2 µm, the laser is also suitable for direct material processing.

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1 Tm:YLF INNOSLAB laser. Source: Berthold Leibinger Stiftung GmbH.

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