Thulium-ytterbium co-doped fiber laser with 75 W of output power at 2 μm

Y. Jeong, P. Dupriez, J. K. Sahu, J. Nilsson, D. Shen, and W. A. Clarkson*
Optoelectronics Research Centre, University of Southampton, Southampton SO17 1BJ, England
** Phone +44 23 8059 3141, Fax +44 23 8059 3142, Email: yoj@orc.soton.ac.uk*
S. D. Jackson
Optical Fibre Technology Centre, Australian Photonics Cooperative Research Centre, The University of Sydney, 206 National Innovation Centre, Australian Technology Park, 1430 Eveleigh, Sydney, Australia

Abstract

Recently, ytterbium-sensitization was developed for thulium-doped fibers for operation at ~2 μm. In these, pump energy at 910 – 980 nm is absorbed by the Yb^{3+}-ions, and then transferred non-radiatively to the lasing Tm^{3+}-ions. This is similar to the operation of the more widespread erbium-ytterbium co-doped fibers. Ytterbium-sensitization takes advantage of the strong broadband absorption of Yb^{3+}-ions in the 900 – 980 nm wavelength range.

Here, we present further power-scaling of a cladding-pumped Tm:Yb codoped fiber laser. A Tm:Yb codoped preform was fabricated at the OFTC in Sydney. From this, a double-clad fiber was drawn at the ORC in Southampton. The fiber had a 18.5 μm diameter, 0.22 NA aluminosilicate core doped with Tm and Yb in equal concentrations (weight fraction 2%). The pure-silica inner cladding had a 300 μm diameter, D-shaped geometry. The inner cladding was coated with a low-index polymer for pump waveguiding. The absorption at the pump wavelength (975 nm) was 4 dB/m. A 2.5 m long TYDF was used in the experiments. The laser cavity was formed between a perpendicularly cleaved fiber facet at the pump launch end and an external, lens-coupled dichroic mirror in the other end of the cavity. A diode-stack pump source was launched into the TYDF. The fiber laser output was taken from the pump launch end via a dichroic mirror, HR around 2 μm. The slope efficiency was 26% and the threshold was 7 W with respect to launched pump power. The maximum output power (75 W) was limited by failure of the core at the out-coupling facet. We did not measure the beam quality or the emission spectrum, but we did determine that the laser operated in the 2 μm wavelength range. Emission at ~1 μm was negligible.