High power 1726nm operation of a thulium fiber laser pumped in-band by an erbium-only fiber laser

M. D. Burns1\*, P. C. Shardlow1, P. Barua1, T. L. Jefferson-Brain1,J. Sahu1, W. A. Clarkson1  
*1. Optoelectronics Research Centre, University of Southampton, Southampton, SO17 1BJ, UK  
\*markburns@soton.ac.uk*

**250 word abstract**

There are a number of spectral features around 1700 nm which are very attractive to the laser community. Strong C-H bond absorption and moderate water absorption lend this region to many applications such as polymer processing and laser surgery. Despite being a growing area of interest, development of high-power, laser sources in this region is quite challenging. Here we present preliminary results of in-band pumping a thulium-doped fiber laser (TDFL) with erbium-only doped fiber laser (EDFL) to generate 1700 nm

Erbium-only was chosen to avoid the power scaling limitations of co-doping with ytterbium. Parasitic lasing on the ytterbium band at 1030 nm results in efficiency roll-off and self-pulsing. Because of this, single-mode Er/Yb laser systems are generally limited to moderate powers of ~20W and reliability remains an issue.

An in-house double-clad large mode-area fiber, with a fundamental mode-field diameter of 20 um, was cladding pumped at 975 nm. Maximum power at 90 W launched was 31 W and the slope efficiency was 44.2% (35.4%) with respect to absorbed (launched) pump power. Suitability for high-brightness core pumping of a TDFL was confirmed with an M2 measurement of 1.1+/-0.1.

For 1700nm generation, the 1580nm pump light was free-space coupled into an in-house TDF (0.2 wt.% dopant concentration). For a maximum launched power of 23W, 15W of 1726nm output was generated with a slope efficiency of 67.1% (64.7%) with respect to absorbed (launched). To the author’s best knowledge, this is the highest recorded power in this wavelength region from a TDFL at the time of writing.

**100 word abstract**

A route to high power continuous wave generation around 1700 nm has been explored using an Er-only doped LMA fiber laser for high brightness core pumping of a thulium-doped fiber laser (TDFL). Maximum output power of 14.9 W with a slope efficiency of 64.7% was achieved at 1726 nm which, to the author’s best knowledge, is the highest recorded power in this wavelength region from a TDFL. The motivation for an Er-only pump source is scalability; these preliminary results show that this configuration has significant potential for further power scaling.