

Ytterbium-doped double-clad large-core fiber lasers with kW-level continuous-wave output power

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We report highly efficient cladding-pumped ytterbium-doped fiber lasers in various configurations, generating up to 1 kW of continuous-wave output power at 1.1 μm with an 80% slope efficiency and a good beam quality.

In recent years the output powers of cladding-pumped ytterbium (Yb)-doped fiber lasers have grown dramatically [1]-[5]. Output powers approaching 500 W have been reported from single-fiber devices [4], while 10 kW of output power has already been achieved from highly multi-moded devices that combined the output power from several fiber lasers [5].

We demonstrate a highly efficient, high doping concentration, double-clad Yb-doped large-core fiber lasers with an excellent beam quality in a single-fiber configuration. The experimental arrangement is shown in Fig. 1. Based on a single fiber with a length shorter than 10 m, the cw output power reaches 610 W and 1 kW at 1.1 μm in different configurations. The slope efficiencies are >80% with respect to launched pump power. Examples of signal output power vs. launched pump power are shown in Fig. 2. We emphasize that a nearly diffraction-limited output ($M^2 = 1.3$) is achieved with a 28- μm core design. No evidence of roll-over in laser output power at the highest launched pump powers is observed, suggesting that our laser could be power-scaled to even higher powers using a more powerful pump sources. Furthermore, the large core and the relatively short lengths of these fibers lead to high nonlinear thresholds, allowing these fibers to be used for high-power amplification of single-frequency as well as pulsed radiation.

Up-to-date results on high-performance, high-power, fiber lasers will be discussed at the conference, including the prospects for further power scaling of diffraction-limited fiber lasers using more advanced core designs and other higher-order mode suppression techniques.

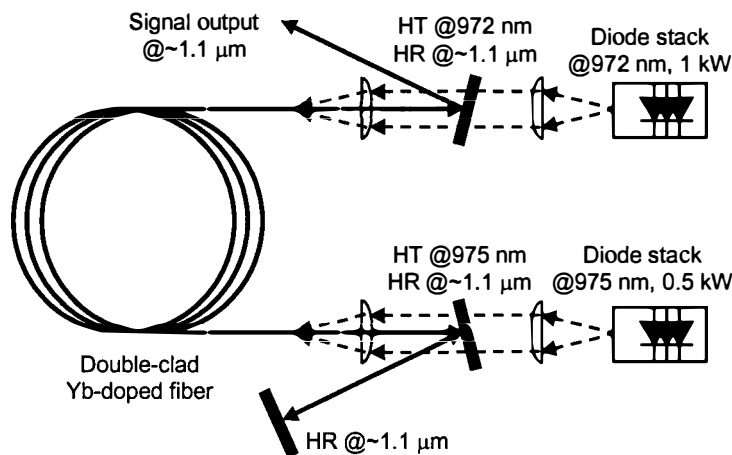
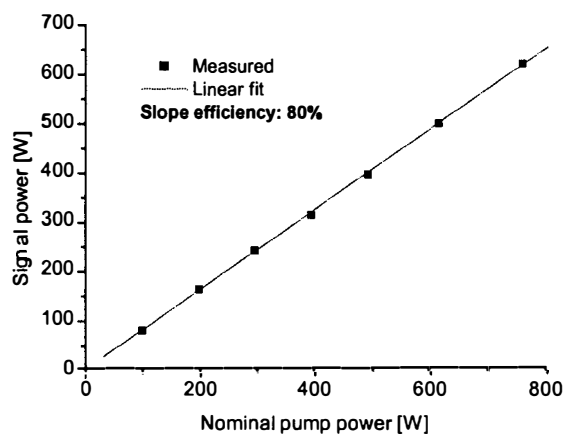
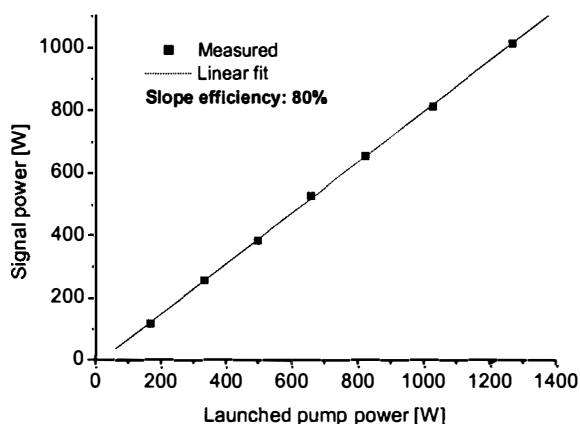


Fig. 1. Yb-doped fiber laser arrangement used with two diode-stack pump sources. HR: high reflectivity, HT: high transmission.



(a)



(b)

Fig. 2. Fiber laser output power vs. launched pump power: (a) 28-μm core, 400/360-μm inner cladding ($M^2 = 1.3$) and (b) 43-μm core, 650/600-μm inner cladding ($M^2 = 3.4$)

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