Highly efficient, high-power short-pulse lasers based on Tm3+ doped materials

28 December 2017

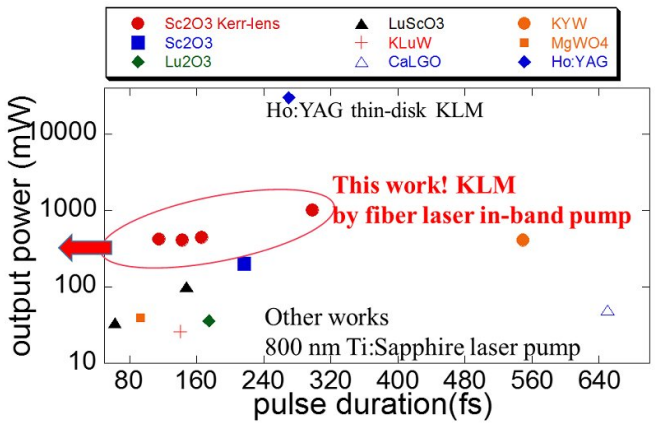

Fig.1. Output powers of Tm doped short pulse laser as a function of pulse duration. Credit: University of Electro-Communications

Highly efficient high power short pulse lasers at the wavelength range of 2 µm based on Tm3+ doped materials have a variety of applications such as material processing, LiDAR, mid-infrared OPOs for wavelengths up to 12 ?m, or mid-infrared supercontinuum generation. They also would enable direct coherent soft X-ray generation by high order harmonics generation.

For these applications, a light source with much higher conversion efficiency, average power, pulse energy, and shorter pulse duration is desirable.

Now, Masaki Tokurakawa and colleagues at Institute for Laser Science, University of Electro-communications, Tokyo, have developed novel 2 µm high power short pulse lasers based on new technique of fiber laser in-band pumping and Kerr-lens mode locking with a new Tm doped gain medium provided from University of Hamburg, Dr. Christian Kränkel.

Pulses as short as 115 fs and output power of 420 mW with conversion efficiency of ~20% were obtained. Compared with prior SESAM mode-locked Tm doped lasers pumped by Ti:Al2O3 lasers, this new method enabled generation of much higher output power and shorter pulse duration with higher conversion efficiency (Fig.1).

This is the first Kerr-lens mode-locking at a wavelength of 2 ?m and it opens up possibilities for new highly efficient high power short pulse lasers at 2 ?m. In the future, sub 50 fs pulse generation at this wavelength range would be possible.

More information: Kerr-lens mode-locked Tm3+:Sc2O3 single-crystal laser in-band pumped by an Er:Yb fiber MOPA at 1611 nm, *Optics Letters*, 42, 3185-3188 (2017).

Eisuke Fujita et al. High power narrow-linewidth linearly-polarized 1610 nm Er:Yb all-fiber MOPA, *Optics Express* (2016). DOI: 10.1364/OE.24.026255

Provided by University of Electro Communications