

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

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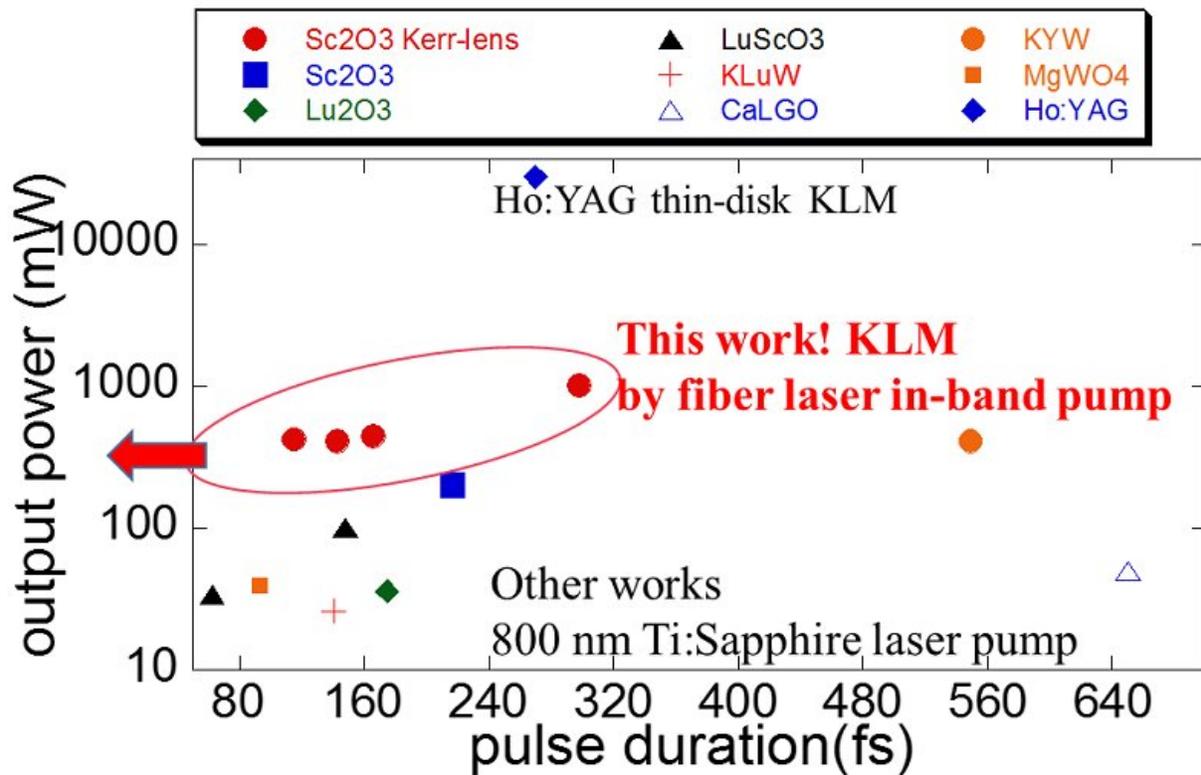


Fig.1. Output powers of Tm doped short pulse laser as a function of pulse duration. Credit: University of Electro-Communications

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 μm , 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 $\sim 20\%$ 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 μm and it opens up possibilities for new highly efficient [high power](#) short pulse lasers at 2 μm . 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

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