# Power-scalable ultrafast Ho:YAG slab amplifier at 2094 nm

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We present an amplifier system for 2 µm ultrafast laser pulses for potential material processing applications. The amplifier gain material is a 0.75 at.% doped Ho:YAG slab crystal measuring 10 mm x 1.5 mm x 55 mm. The pump source is an in-house developed continuous wave Tm:YLF slab laser which produces a maximum output power of 340 W, centred at the 1908 nm Ho:YAG absorption peak. The pump beam full widths were 0.2 mm by 5.3 mm in the slab. The seed for the experiment was a mode-locked Tm:LuScO3 laser that produced 200 fs pulses (~23.6 nm spectral bandwidth) centred at 2094 nm. The spectral peak of the seed laser was chosen so as to spectrally overlap both the 2090 and 2097 nm emission peaks of Ho:YAG. The pulse repetition frequency of the seed laser was 115 MHz, and the average power as measured after an optical isolator was ~57 mW. In the initial experiment the seed was focused into the slab using a spherical doublet lens pair to a beam diameter of 0.2 mm. The measured single pass gain was ~10 (0.54 W) when pumped with 280 W. The effective pump power (disregarding transmitted pump light) in the gain volume used for amplification was estimated to be 8.3 W. The spectral bandwidth of the output signal was measured at several output powers and shown to converge to ~11.8 nm. Based on these results and in-house simulations we will implement a pre-amplifier and scale 2 µm ultrashort pulses to >100 W average power at MHz PRFs.