Externally modulated, diode seeded Yb^{3+}-doped fiber MOPA pumped high power optical parametric oscillator

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Here we report a high power, pulsed optical parametric oscillator (OPO) at 3.5 µm by using a MgO:PPLN crystal as the gain medium. The OPO itself was pumped by a semiconductor diode-seeded, Yb^{3+}-doped fiber Master Oscillator Power Amplifier (MOPA) operating at 1062nm. An OPO output power as high as 11W at an overall slope efficiency of 67% was achieved, with nearly 2.7W and 8.2W of optical power obtained at 3.5µm and 1.5µm respectively. Due to the fast response time of the external modulator, it is possible to implement active pulse shaping on a nanosecond time-scale . Using adaptive pulse shaping of the seed laser (using an external modulator) we demonstrated a reduction in the impact of dynamic gain saturation and optical Kerr/Raman nonlinearities within the fibre MOPA obtaining shaped signal and idler pulses at the OPO output and reduced spectral bandwidths. We have also investigated the dependence of the OPO build-up time and energy transfer efficiency on pump pulse peak power and shape. The build-up time shows an exponential dependence on the pulse peak power and as expected decreases with an increase in pulse peak power. Analyzing the shift in spectral peak at 1.5µm it is possible to estimate the internal temperature of the crystal for various pump powers. Our experiments were pump-power limited and considerable scope remains for further power-scaling of the OPO output using this approach.