

## HIGH POWER, PULSED OPTICAL PARAMETRIC OSCILLATOR AT $3.5\mu\text{m}$ PUMPED BY A DIODE SEEDED $\text{Yb}^{3+}$ -DOPED FIBER MOPA

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**Abstract:** We report a high power pulsed optical parametric oscillator (OPO) at  $3.5\mu\text{m}$  using a MgO:PPLN as the gain medium pumped by 1062nm all-fiber MOPA. Output powers as high as 11W at an overall slope efficiency of 67% was achieved, with nearly 2.5W of power obtained at a wavelength of  $3.5\mu\text{m}$ .

### 1. INTRODUCTION

High power, nanosecond optical parametric oscillators (OPO) working in the mid-infrared wavelength range are required for many aerospace and sensor applications.

There have been numerous reports on high power fiber laser pumped, PPMgLN based OPOs over the years [1][2][3]. High average power parametric output in excess of 10 W around 3 microns was reported from a PPMgLN-based OPO pumped by a 50W continuous wave (CW) Yb doped fiber laser [2]. However, in the case of pulsed operation, where the peak powers are typically much higher than in the CW mode, the maximum average output power so far reported for parametric conversion in the 3-4 micron range has been limited to around 1W level [3].

Here, we report a fiber MOPA pumped MgO:PPLN based OPO generating 2.7W and 8.2W of output power at  $3.5\mu\text{m}$  and  $1.5\mu\text{m}$  respectively at an overall conversion efficiency of 52%.

### 2. EXPERIMENTAL RESULTS

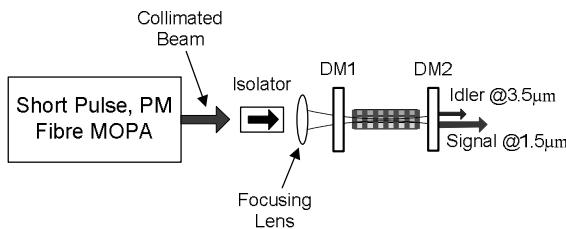


Figure 1: Schematic of the OPO setup.

DM1 - HT @  $1.0\mu\text{m}$ ; HR @  $1.5\mu\text{m}$  &  $3.5\mu\text{m}$   
 DM2 - HR @  $1.0\mu\text{m}$ ; OC @  $1.5\mu\text{m}$  &  $3.5\mu\text{m}$

Figure 1 shows the experimental setup for OPO generation. High peak power pulses at 1062nm from an all-fiber PM MOPA were focused into a 50mm long MgO:PPLN crystal using 300mm focal length lens. The beam diameter at the waist position was  $200\mu\text{m}$ . The OPO was configured in a simple linear cavity geometry. The threshold pump power for the

OPO was  $\sim 5\text{W}$  corresponding to a pulse peak power of 1kW. The detailed output versus pump power characteristic for the parametric oscillator is illustrated in Figure 2. A slope efficiency of 67% was achieved at maximum pump power. No roll off in the combined (signal + idler) power implies that the output power of our parametric oscillator is limited by the available pump power.

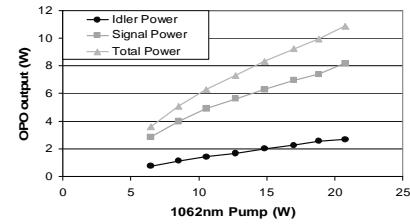


Figure 2: Parametric output powers vs pump power

We have also investigated the dependence of the OPO build-up time as well as the energy transfer efficiency on pump pulse peak power and shape.

### 3. CONCLUSION

We have successfully demonstrated a fiber laser pumped OPO generating 11W of combined output power with 65% slope efficiency.

### REFERENCES

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