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Mid-Infrared doubly-resonant Optical Parametric Oscillator based on ZnGeP₂

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Abstract content
   (Max 300 words)

Laser sources emitting in the 3-5 micron wavelength region is of particular interest for applications in medicine (tissue ablation), remote sensing (LIDAR) and the military (directed infra-red countermeasures).
However; while solid state laser sources in the 1 micron region (Neodymium based lasers) are well established and sources in the 2 micron region are maturing (Holmium and Thulium based lasers); sources in the 3 to 5 micron region are still limited.
An efficient path to obtain coherent light in the 3-5 micron region is by converting light from a 2 micron laser source, such as a solid-state Ho:YLF laser, through the use of an optical parametric oscillator (OPO).
Here we present a high-power mid infra-red optical parametric oscillator (OPO) based on ZnGeP₂ (ZGP). The ZGP crystal was pumped with an in-house developed Ho:YLF slab laser. The OPO consisted of a linear cavity, double passing the pump light through the ZGP crystal with the use of an output coupler mirror that was highly reflective at 2 micron. The input coupler mirror was highly reflective for both the signal and the idler while the output coupler mirror was partially reflective for both, thus making a doubly-resonant OPO.
The OPO had a slope efficiency of 30% from incident power to the combined signal and idler output power (from the ZGP OPO) when operating at a pulse repetition rate of 5 kHz. Through rotation of the ZGP crystal, output could be obtained from as short as 3515 nm, and as long as 4993 nm. A maximum output power of 1 W was measured when limiting the incident pump power to 7 W. The OPO exhibited a good beam quality.

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