International Conference on Space Optics—ICSO 2012

Ajaccio, Corse

9–12 October 2012

Edited by Bruno Cugny, Errico Armandillo, and Nikos Karafolas

High energy optical parametric source for multi-wavelength CO2 dial

Jessica Barrientos-Barria

Jean-Baptist Dherbecourt

Myriam Raybaut

Antoine Godard

et al.

International Conference on Space Optics — ICSO 2012, edited by Bruno Cugny, Errico Armandillo, Nikos Karafolas
Proc. of SPIE Vol. 10564, 105642H · © 2012 ESA and CNES · CCC code: 0277-786X/17/\$18 · doi: 10.1117/12.2309277

Proc. of SPIE Vol. 10564 105642H-1

High energy optical parametric source for multi-wavelength CO₂ DIAL

Jessica Barrientos-Barria, Jean-Baptiste Dherbecourt, Myriam Raybaut, Antoine Godard,
Jean-Michel Melkonian, Michel Lefebvre

ONERA, the French Aerospace Lab, DMPH, Chemin de la Hunière, F-91761 Palaiseau, France
myriam.raybaut@onera.fr

In the scope of the preparation of spaceborne lidar missions to measure the concentration of greenhouse gases with differential absorption LIDAR techniques, we report on the development of a high energy 2.05 μm optical parametric source based on a versatile architecture enabling multiple wavelengths generation in the vicinity of the R30 absorption line of CO₂. The multi-wavelength configuration is under study for a few greenhouse gas active detection missions, such as Ascend.

The experimental set-up is depicted in Fig.1. It is based on a high energy (tens of mJ) nanosecond Nd:YAG laser used as a pump source for a Master Oscillator Power Amplifier (MOPA) parametric frequency converter. The MOPA configuration enables to reach high pulse energy in the mid-infrared (> 10 mJ at 2.05 μm) while maintaining high spectral and spatial quality [1]. The oscillator is based on a nested cavities doubly resonant optical parametric oscillator (NesCOPO) [2] with a type II PPLN nonlinear crystal. This specific architecture developed at ONERA enables single-mode operation, and the generation of wavelength sequences with adjustable span and resolution. The OPO radiation is then used to seed a type 0 PPLN preamplifier and four KTP amplifiers in order to reach high conversion efficiency.

Figure 1: Experimental scheme (a) and conversion efficiency measurement through pump depletion ratio (b).

Fig.1.(b) shows a 50 % pump depletion after all the amplification stages, and the extracted signal energy at 2.05 μm was measured to be ~ 15 mJ, which reaches power requirements for atmospheric DIAL. Further spectral, spatial and power characterizations, as well as specific tuning procedures for lidar applications will be presented.

This work has been partially supported through contract 19813, "Pulsed Laser Source in NIR for Lidar Applications", within the Technology Research Programme of the European Space Agency (ESA), and partially supported by CNES through contract 115606/00, "Source paramétrique multi-longueurs d'onde pour Lidar DIAL", of the Research and Technology programme.

References

- [1] M. Raybaut & al. "High-energy single-longitudinal mode nearly diffraction-limited optical parametric source with 3 MHz frequency stability for CO₂ DIAL," *Opt. Lett.* **34**, 2069-2071 (2009)
- [2] B. Hardy & al. "Compact, single-frequency, doubly resonant optical parametric oscillator pumped in an achromatic phase-adapted double-pass geometry," *Opt. Lett.* **36**, 678-680 (2011)