THERMO-MECHANICALLY RUGGED OPO DEMONSTRATOR MODEL FOR CLIMATE MISSION MERLIN

Task

As a greenhouse gas, methane has a significant share in in-fluencing climate change. By comparison, however, the global distribution as well as sources and sinks of the gas are poorly understood. Within the scope of the German-French Climate Mission »MERLIN«, a satellite-based LIDAR system shall be used to gather detailed and global density distributions of methane. The transmitter is a Q-switched Nd:YAG laser as a pump laser combined with an optical parametric oscillator (OPO) as a frequency converter. The OPO converts the laser output wavelength of 1064 nm into a characteristic methane absorption line at about 1645 nm. After the required output parameters of the OPO were demonstrated on a laboratory setup with classical mounting technology, the constructive feasibility of the conceptual design as a more robust demonstrator shall be shown. This particularly concerns the thermo-mechanical stability of the structure under non-operational thermal transport conditions: from -30° C to +50° C. For the resonator optics of the OPO, tilt stabilities have to be maintained within a 10 µrad range.

Method

The mechanical implementation of the demonstrator model is based on the optical design of the lab setup. The optical elements of the OPO, crystals and mirrors are soldered on metallic holders adapted to this purpose. These have been developed at Fraunhofer ILT to withstand the operating conditions of satellite-based lasers and are characterized by a large mechanical and thermo-mechanical stability. In order to ensure a high quality of solder joint, both the melting cycles and, thus, the number of adjustment steps were limited. Therefore, to construct the OPO, the strategy to adjust the optical components has been adapted to these characteristics of the assembly process.

Result

Two OPO modules have been successfully constructed and adjusted based on the soldering technology. They showed the same conversion efficiency as with OPOs constructed using conventional holders. Even after passing through an air cycle test, both modules exhibited the same efficiency as before.

Applications

The implementation of robust construction technique can also be used in OPOs in other wavelength ranges operating under demanding environmental conditions. In this way, a large number of relevant gases can be detected.
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Contacts

M.Sc. Marie Jeanne Livrozet
Telephone +49 241 8906-8010
marie.livrozet@ilt.fraunhofer.de

Dr. Bernd Jungbluth
Telephone +49 241 8906-414
bernd.jungbluth@ilt.fraunhofer.de

3 Mechanically stable, optical parametric oscillator.