ND:YLU GG LASER FOR FUTURE SATELLITE BASED WATER VAPOR DIAL SYSTEMS

Task

In the future, it is expected that precise, global measurement of water vapor distribution in the atmosphere will significantly enhance the accuracy of numerical weather prediction and improve the general circulation models used for climate research. The goal is to achieve this by deploying satellite-based DIAL (Differential Absorption LIDAR) systems operating in the 935 nm range. The European Space Agency (ESA) has analyzed the requirements for these systems as part of its WALES project. The OPO and Ti:sapphire lasers used to date are comparatively complex and only exhibit limited suitability for satellite deployment due to their electrical-to-optical efficiency of around 1.5 percent. In stoichiometrically adjusted Nd-doped mixed-garnet crystals, the wavelength can be directly generated through diode pumping. Satellite deployment requires a pulse energy of around 70 mJ at a repetition rate of 100 Hz, pulse durations of less than 100 ns with a line width of < 160 MHz and a spectral purity of > 99.90 percent. The aim of the project was to demonstrate that these values can be achieved.

Method

A Nd:YGG-based MOPA was constructed based on INNOSLAB amplifier technology and characterised by taking measurements of atmospheric water vapor. To set different wavelengths within a range of 935 -936 nm (vac.), Nd:YxLu1−xGa5O12 crystals (Nd:YLuGG) with variable stoichiometry x were investigated.

Result

In collaboration with the Institute of Atmospheric Physics of the German Aerospace Center (DLR), atmospheric water vapor was measured with a Nd:YGG system for the first time. The laser delivers 30 mJ at 100 Hz and is tunable over a 0.45 nm range centered around 935.31 nm (vac.). To obtain the relevant wavelengths for a WALES system of around 935.73 nm (vac.), an Nd:YxLu1−xGa5O12 crystal was identified. The properties of this spectrally adapted laser are the subject of work that is currently in progress.

Applications

In addition to the deployment of an Nd:YLuGG-based system within the WALES context, application-specific wavelengths can also be generated on a more general basis by using customized laser crystals. This process requires precise analysis of the crystal properties and a laser design tailored to each specific application.

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