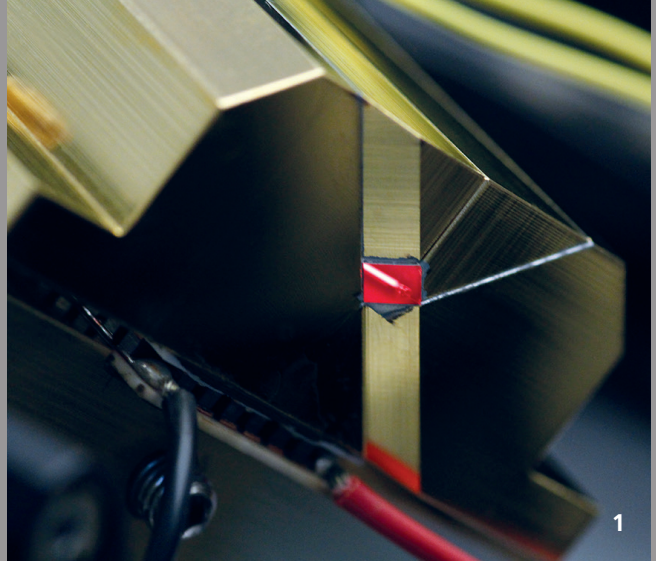

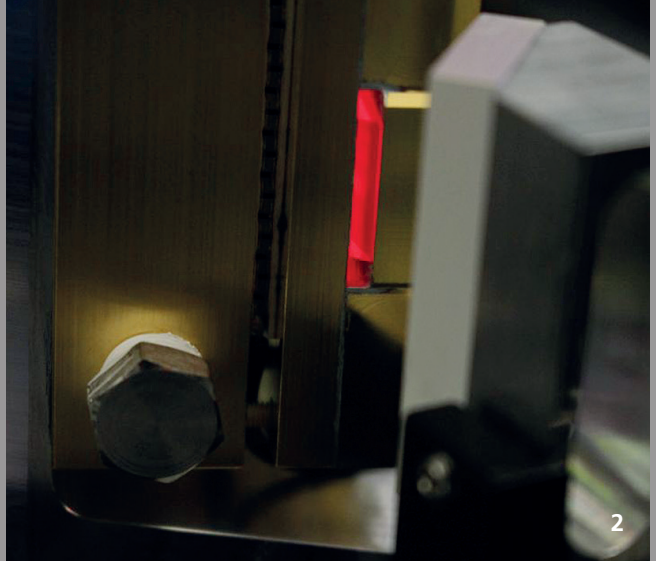

HIGH-STABILITY HO:YLF OSCILLATOR

Task

Laser beam sources in the wavelength range around 2 µm and with pulse lengths in the nanosecond range can be applied in many different areas: materials processing, remote sensing, science and military can all make use of the special absorption properties of 2 µm radiation. As part of the DLR project »CHOCLID« and the ESA project »HOLAS«, a pulsed, spectrally narrow beam source with a particularly high wavelength stability at 2.051 µm is being developed to detect CO_2 in the atmosphere.

Method

A Ho:YLF-MOPA system based on INNOSLAB, which is pumped by diode-pumped Tm:YLF lasers, was designed by means of numerical simulations to generate the required double pulses with 45 mJ and 15 mJ pulse energy and a repetition rate of 50 Hz. Pulses with a constant energy of 2 mJ are generated in the oscillator. A high spectral stability has been achieved as a cavity with high finesse is used for the oscillator and an optically pumped semiconductor disc laser (OPSEL) for the seed source.

Results

As a pump source for the Ho:YLF oscillator, Fraunhofer ILT constructed a Tm:YLF rod laser with a cw power of 15 W and whose power is limited by the pump diodes used.

This pumped Ho:YLF oscillator produces longitudinal single-mode, diffraction-limited pulses at a 50 Hz repetition rate, a 2 mJ pulse energy with a pulse duration of 25 ns. The spectral bandwidth is 1 MHz (RMS) and the time-bandwidth product is bandwidth limited by approximately 0.44. With an Allan deviation of less than 40 kHz for 10 seconds, the spectral stability is significantly better than the required 200 kHz. For single pulses with a repetition rate of 100 Hz, 11 mJ have been generated. Testing at high pulse energies shows that there is a great distance from the destruction threshold at the working point of 2 mJ. In cw operation, an optical-optical efficiency of 53 percent has been achieved. An Ho:YLF INNOSLAB amplifier has also been built and is currently being tested.

Applications

As well as a master oscillator for the following amplifier, the oscillator can be used in materials processing. The output wavelength of 2 µm is also advantageous for use as a source to pump efficient optical-parametric frequency converters for the long-wave infrared spectral range.

The R&D project underlying this report was carried out on behalf of the Federal Ministry of Education and Research under grant number 50EE1222.

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1 Pumped Ho:YLF crystal of the oscillator.

2 Pumped laser crystal of the Ho:YLF INNOSLAB amplifier.

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DQS certified by DIN EN ISO 9001, Reg.-No.: DE-69572-01