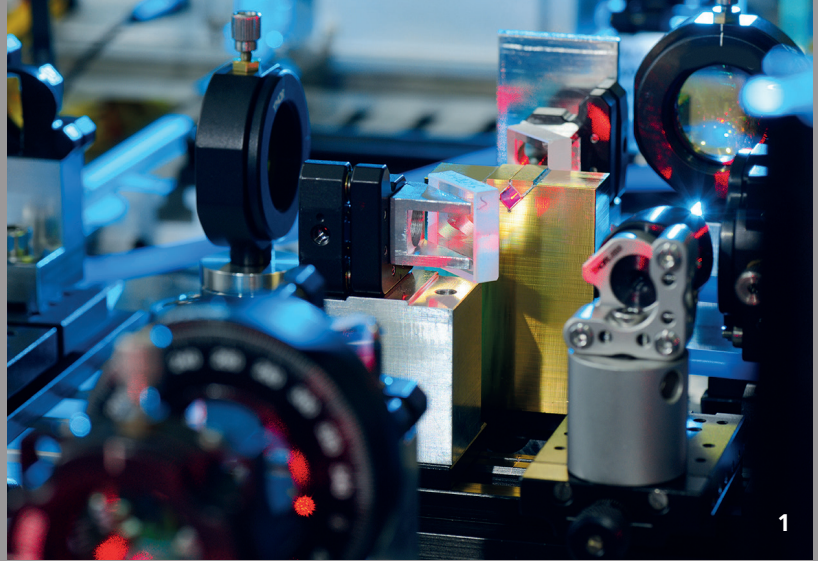

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AMPLIFIER FOR PULSED LASER RADIATION WITH 2.9 µM EMISSION WAVELENGTH

Task

Within the cooperative Fraunhofer-Max-Planck project DIVESPOT, Fraunhofer ILT is investigating the direct amplification of laser pulses in the MIR range with output wavelengths around 3 µm, pulse durations below 1 ns and repetition rates in the kHz range. Novel amplification materials are used to address the wavelength range without nonlinear processes. The project aims to develop a new tool for surgery, e.g. for the removal of soft tissue. Laser pulses with a pulse duration of less than 1 ns and a wavelength around 3 µm generate a particularly small heat-affected zone due to high absorption and short duration. The targeted biological tissue can thus be ablated without damaging the surrounding tissue.

Method

The chromium-doped II-VI compound semiconductor material zinc selenide is used as the amplifying medium. Since the luminescence lifetime of Cr:ZnSe in the upper state at room temperature is only about 5 µs, the pump power must be provided in high-energy, short pulses for efficient pumping. Therefore, Q-switched thulium solid-state lasers with a wavelength of 1.9 µm and pulse lengths of a few 100 ns are used as pump sources. The laser beam source was built as a master oscillator power amplifier (MOPA), whereby a seed laser beam source with few µJ pulse energy was amplified in a double pass through two rod-shaped amplifier stages.

1 Amplifier stage with Cr:ZnSe amplification medium.

Results

A two-stage laser amplification system based on the amplification medium Cr:ZnSe was built. With this system, Fraunhofer ILT was able to demonstrate a maximum gain of about 10 and a pulse energy of more than 300 µJ at a repetition rate of 1 kHz. The pulse duration of the laser radiation with an emission wavelength of 2.91 µm was about 1 ns.

Applications

Laser beam sources in the MIR are suitable for use in the medical field, e.g. as laser scalpel for soft tissue applications, but also for other materials that have a high absorption in the MIR such as plastics. Furthermore, these laser beam sources can be used for molecular spectroscopy.

The project DIVESPOT has been funded within the Fraunhofer-Max-Planck cooperation program.

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