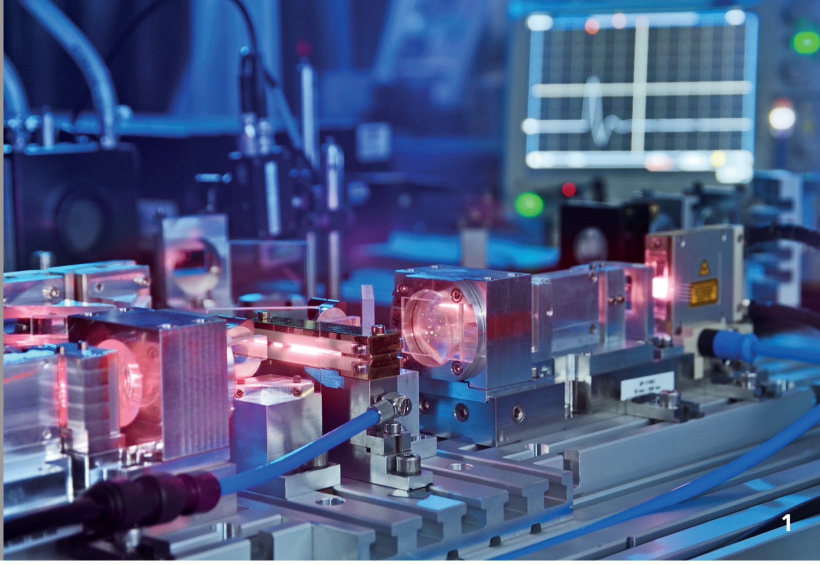

Subject to alterations in specifications and other technical information. 06/2019.

ND:INNOSLAB HIGH-GAIN LASER AMPLIFIER WITH 400 W OUTPUT POWER

Task

Today, short-pulse lasers with pulse durations in the sub-ns range are used in numerous applications in laser material processing, such as in the automotive industry, in electronics or in the structuring of thin films. Here, challenges are scaling the laser power, reducing the manufacturing costs and simplifying the beam source while making the system highly robust. Currently, high-power short-pulse beam sources usually consist of a mode-locked oscillator and a subsequent multi-stage amplifier. Among others, the BMBF-funded joint project »IMPULS« aims to develop a laser amplifier for sub-ns pulses; such an amplifier should make it possible to generate the highest possible amplification and to scale the output power in a range above 300 W at pulse repetition rates of a few 100 kHz. Moreover, it is planned to use only one amplifier stage.

Method

The objective is to be achieved by optimizing the established Nd:YVO_4 crystal-based INNOSLAB design. For this purpose, Fraunhofer ILT is investigating technologies such as in-band pumping, the adaptation of the crystal geometry and heat sink and a favorable doping profile in the laser crystal. The beam propagation of the beam to be amplified in the laser amplifier represents another degree of freedom that is optimized for achieving maximum gain.

Results

A mean laser power in excess of 400 W has been achieved with a single stage INNOSLAB amplifier at pulse repetition rates in excess of 400 kHz and pulse lengths of 10 ps and 300 ps. Here, a pulse energy of 950 µJ was also shown for pulse lengths of 10 ps at 392 W average power. The beam quality without further filtering is $M^2 < 1.5$ with an o/o efficiency of more than 40 percent. The institute has demonstrated an efficient single-stage gain of more than 470 for an input power from 0.5 to 235 W output power.

Applications

With the parameters shown, the developed laser beam source is suitable, in particular, as a fundamental beam source for frequency conversion. For this reason, the »IMPULS« project also includes work on frequency conversion to UV and MIR and comparative experiments on laser material processing, in addition to providing the fundamental wavelength of 1064 nm. The experiments will be carried out on different components from the automotive industry and especially address components made of polymer materials and fiber composites.

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1 Single-stage 400 W Nd:YVO_4 laser amplifier.

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