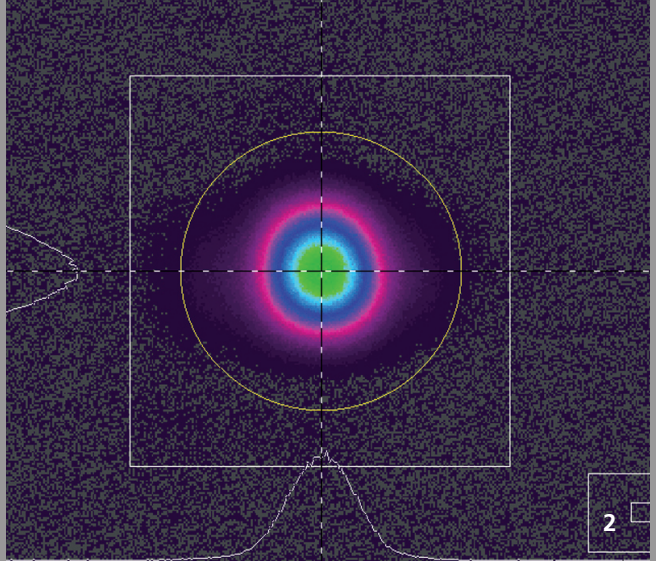

HIGH-POWER YB:INNOSLAB AMPLIFIER WITH SPACE FILTER

Task

Ultra-short pulse lasers have found a wide range of applications in science and industry. From a beam source for particularly precise applications, for example in micro-structuring, a very excellent beam quality is expected, in an ideal case, one that is diffraction limited. At the same time, for a cost-efficient use of the expensive beam sources, a large throughput and, therefore, high mean power is desired.

When fs oscillators and Yb:INNOSLAB amplifiers are combined, output powers up into the kW range can be generated, all with a beam quality of a minimum of M^2 = 1.05 x 1.40. This is, however, not sufficient for some applications. The varying beam quality in the transversal directions can also present a limitation.

Method

In order to improve the beam quality of Yb:INNOSLAB amplifiers with sub-picosecond pulse durations, a compact high-power spatial filter was developed.

The main component is a dielectric mirror in which a 300 µm wide slit has been inserted through the use of inverse laser drilling. This mirror is used in an intermediate focus position in the cylinder telescope needed for beam forming. The typical diffraction structures of an INNOSLAB laser are, thus, cut off in the far field. The laser radiation filtered out is carefully guided into a beam dump.

Result

At 600 W of mean output power, the beam quality could be improved to M^2 = 1.05 x 1.15 by cutting off less than 10 percent of the power. When the slit mirror is combined with a linearly formed intermediate focus, stable operation is secured at high mean power and a simple adjustment of the aperture.

Applications

Inverse laser drilling can be used to drill as complex a geometrical shape as desired with high aspect ratios in 2.5 D in mirror substrates or other glass bodies. This way, compact spatial filters for lasers with high mean power can be generated. The diffraction-limited high-power ultra-short pulse laser is, thus, only one of many possible fields of application.

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1 Laser-drilled slit mirror.

2 Beam profile of the filtered beam.