DIODE-PUMPED GAIN-SWITCHED FIBER LASERS

Task

In addition to diode-seeded fiber amplifiers and Q-switched fiber lasers, the gain-switched fiber laser constitutes an alternative concept for pulse generation, especially at low repetition rates. In the gain-switched fiber laser the signal pulse is generated by pulsing the pump source. Subsequent frequency conversion poses a particular challenge since it calls for a pulse power that is as high as possible combined with low spectral bandwidth of the gain-switched fiber laser. This is being investigated experimentally and theoretically as part of the "Fazit" project, which is funded by Germany's Federal Ministry of Education and Research (BMBF).

Method

The gain-switched fiber laser can be configured as an entirely monolithic resonator with fiber Bragg gratings using multiple fiber-coupled pump modules in pulsed mode. In addition to implementing a resonator pumped from both sides, a setup optimized for frequency conversion with narrow bandwidth and linear polarization needs to be demonstrated as a gain-switched fiber master oscillator with subsequent pulsed-pumped fiber amplifier.

Result

The gain-switched fiber laser pumped from both sides achieved repetition rates up to 10 kHz, a peak pulse output power up to 10 kW, and a pulse duration down to around 40 ns.

The setup optimized for frequency conversion with subsequent fiber-integrated amplification provides linearly polarized output radiation with a peak power of over 2 kW and approx. 150 ns pulse duration with a spectral width of less than 350 pm at 90 percent enclosed power. The subsequent frequency conversion to 532 nm already achieved an efficiency of approx. 37 percent in an initial test.

Applications

Due to the excellent beam quality, pulsed fiber lasers are used in many areas of materials processing, metrology and telecommunications technology. However, their tendency toward amplified spontaneous emission (ASE) means the potential parameter scope of conventional fiber lasers is limited in terms of repetition rate to over 10 kHz. The concept of the gain-switched fiber laser provides a solution to this problem. Hence, gain-switched fiber lasers are used wherever high peak power is required in the region of several kW with fundamental-mode beam quality at low repetition rates down to single-shot operation.

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