FIBER-INTEGRATED RAMAN AMPLIFIER FOR PICOSECOND PULSES

Task

The high amplification per round trip in ytterbium-doped fiber amplifiers also leads to high amplified spontaneous emission (ASE). For short pulse durations with low repetition rates and generally with low average seed power, the high levels of ASE limit the output power. As an alternative concept, a Raman amplifier for short pulse durations with a pulsed pump source is to be set up and investigated. Here, the stimulated Raman scattering in fibers is utilized which, unlike direct amplification in the ytterbium fiber amplifier, does not lead to ASE.

Method

To implement the Raman amplifier, a pulsed ytterbium fiber amplifier with a wavelength of 1020 nm is set up as a pump source and used to amplify the signal of a single-mode diode via Raman scattering in a 25-m-long fiber.

Result

The signal, with a pulse duration of approx. 100 ps and a wavelength of 1064 nm, is amplified by up to 32 dB to a peak pulse power of around 200 W as a result of the pump pulse propagating simultaneously through the fiber with a pulse duration of 1.7 ns. The conversion of the pump pulse power to the signal pulse power is very efficient with up to 99 %. Due to the high power transfer and the instantaneous interaction of the Raman scattering, the problems associated with ASE development do not occur.

Applications

Thanks to its high amplification even at very low input power and short pulse durations, the Raman amplifier can be used as a low-noise, high-power seed source in cascaded amplifier chains. This means Raman amplifiers with subsequent re-amplification can be applied to typical fiber laser tasks in materials processing such as marking, cutting and welding, metrology and medical technology.

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