High power fiber lasers and amplifiers

Dr. Bülend ORTAÇ

Friedrich-Schiller-University Jena, Institute for Applied Physics, Jena, Germany

ABSTRACT

Rare-earth-doped fibers are one of the most promising solid-state laser concepts for efficient diode-pumped high power continuous wave and pulsed laser systems. Their main performance advantages are due to the outstanding thermo-optical properties of an actively doped fiber. The large ratio of surface to active volume of such a fiber ensures excellent heat dissipation, furthermore the beam quality is given by the refractive index profile of the active core and is therefore independent of the pump power. Due to the recent developments of reliable high brightness all solid state pump sources and the advances in fiber manufacturing technology these devices are no longer restricted to low-power operation. Continuous-wave (CW) output powers above the kW-barrier have been demonstrated with diffraction-limited beam quality. However, even the most advanced fiber laser is limited by nonlinear effects, fiber facet damage or thermal issues at a certain power level. Spectral beam combining (SBC) is a power scaling concept for fiber lasers, where several individual lasers with different wavelengths are overlapped utilizing a dispersive element. We will present a combination of CW fiber laser systems or fiber amplified pulsed systems. Rare-earth-doped fibers have established themselves as a very attractive gain medium for ultrashort pulse amplification. State-of-the-art systems in the lab deliver femtosecond pulses with several 10 nJ pulse energy for fiber oscillators and an average power of 100 W with pulse energies well above 100 μJ for fiber amplifier systems. These examples will be described in terms of the fiber designs as well as the performance and limitations of the systems.