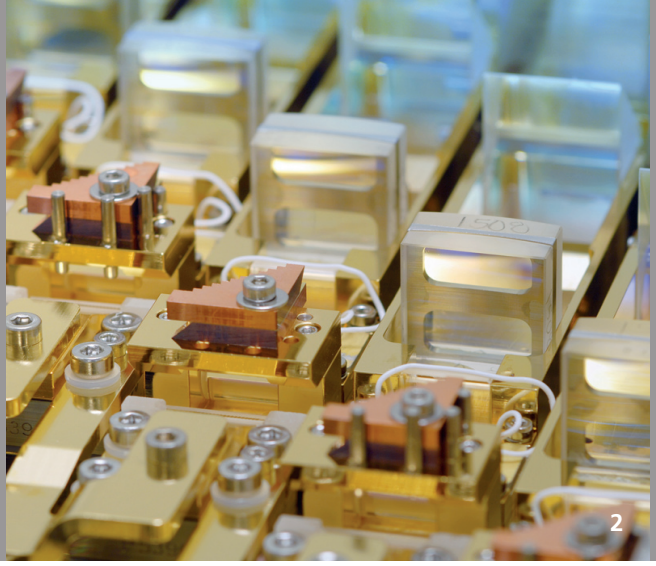

HIGH-POWER DENSE WAVELENGTH DIVISION MULTIPLEXING WITH VOLUME BRAGG GRATINGS

Task

Direct materials processing with diode laser radiation as well as the efficient pumping of several laser-active media require a comparatively large radiance. Thanks to the high-power multiplexing of diode laser radiation, frequency-stabilized diode laser beam sources are overlapped spectrally dense, whereby the radiance is increased when compared to conventional diode laser beam sources.

Method

The compact multiplexer presented here consists of four identical Volume Bragg Gratings (VBGs) with a diffraction efficiency of 99 percent and an incidence angle of 15°. The input wavelengths are 973 nm, 974.5 nm, 976 nm, 977.5 nm and 979 nm. Five mirrors are used to compensate for beam displacement and angle errors of the beam sources. An optional temperature control (DTC dynamic temperature control) of the VGBs enables the central wavelengths of the multiplexer to be adapted to the emitted wavelengths of the input radiation.

2 Detailed view of a spectrally stabilized diode-laser module.

3 Detailed view taken within the multiplexer.

Result

The optical-optical efficiency of the multiplexer is dependent upon the residual divergence and, thus, the beam quality of the input radiation. Fundamental mode radiation is superimposed at an efficiency of 97 percent; radiation at an average beam propagation factor of $M^2 = 45$ is superimposed at an optical-optical total efficiency of 85 percent. The output power of the laboratory demonstration model amounts to a maximum of 200 W, the beam density approx. 70 $GWm^{-2}sr^{1}$.

Applications

The multiplexing technology presented here has been primarily developed to scale the power of diode laser systems for direct materials processing. Furthermore, the pumping of solid-state and fiber lasers is enabled by means of highly brilliant diode laser radiation. This multiplexing technology, based on VBGs, is not limited to use with diode laser radiation, but can also be used in the same design for solid-state lasers such as fiber laser and disc laser sources.

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