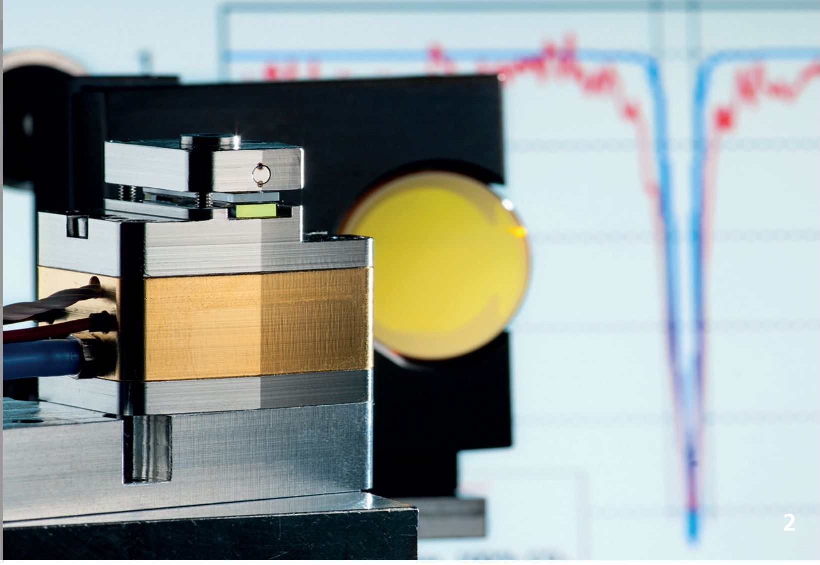

OPGaAs-OPO WITH 10 µm WAVELENGTH

Task

The mid-infrared (MIR) spectral region is of great importance because many atoms and molecules exhibit high and specific absorption in MIR. Where applications place special demands on the spectral and temporal characteristics of the emission, the CO_2 and quantum cascade lasers currently available in this wavelength range often reach their limits. Optically parametric oscillators (OPO), however, can cover such needs.

Method

If orientation-patterned gallium arsenide (»OPGaAs« for short) is used as the nonlinear medium, OPOs can generate radiation at wavelengths of more than 15 µm. OPGaAs is characterized by its broadband transparency in MIR, its high effective nonlinearity and resistance to destruction.

The OPO implemented here is pumped with a pulsed thulium fiber laser. At the crystal, the laser provides an average input power of up to 13.5 W at a repetition rate of 50 kHz and a pump pulse duration of 150 ns. The OPO converts the wavelength of the laser radiation from 1.95 µm into the spectral range between 10 µm and 11 µm (idler radiation). The exact output wavelength is set by the temperature of the OPGaAs crystal.

The bowtie cavity of the OPO is resonant only for the signal wavelength generated simultaneously in the crystal (about 2.4 µm). Pump and idler waves are coupled out at the first resonator mirror behind the crystal and then separated with a dichroic mirror.

Results

The OPO achieves an average idler power of up to 1.07 W. The beam quality M^2 – 1.42 and 1.62 in the horizontal and vertical directions, respectively – is slightly higher than the values of the pump beam. The duration of the idler pulses is 130 ns. The measured values correspond to a conversion efficiency of pump to idler power of approx. 8 percent. The corresponding quantum conversion efficiency is calculated to 43 percent, the corresponding power of the signal wave to about 5 W at 2.4 µm.

Applications

Based on the design presented here, output wavelengths between about 2 µm and 15 µm can be generated when adapted components are used. This enables a range of metrological applications, for example in environmental analysis or atmospheric research, but also in material processing.

Contact

Dr. Jochen Wüppen
Telephone +49 241 8906-8020
jochen.wueppen@ilt.fraunhofer.de

Dr. Bernd Jungbluth
Telephone +49 241 8906-414
bernd.jungbluth@ilt.fraunhofer.de

2 Crystal oven with OPGaAs crystal.