



## PULSED NANOSECOND LASER AT 3 $\mu\text{m}$ WAVELENGTH

### Task

Many materials absorb laser radiation in the mid-infrared (MIR) to a far greater degree than they do at a wavelength of 1  $\mu\text{m}$ . In order to make use of this absorption and expand the range in which a commercial cleaning laser can be used, Fraunhofer ILT shall convert the wavelength of a laser from 1  $\mu\text{m}$  to 3  $\mu\text{m}$ . The converter shall be designed as a downstream module to the existing system. The solid-state laser used provides an average power of 115 W at a pulse duration of 120 ns and pulse frequency of 12 kHz at the fundamental wavelength of 1064 nm. The randomly polarized emission and limited beam quality ( $M^2 = 18$ ) of the laser represent a challenge, however, for efficient conversion.

### Method

So that the entire randomly polarized radiation can be used for the frequency conversion, the raw beam was separated into the two linear polarization components. One of the two beams was guided in an optical parameter oscillator (OPO) that generates radiation at 1645 nm and 3012 nm. The radiation generated at 3012 nm was mixed with the second portion of the raw beam at 1064 nm in an optical parameter amplifier (OPA) and thereby amplified. Periodically polarized lithium niobate (PPLN) was used as a non-linear medium in both the OPO and OPA.

### Results

The output wavelengths of the frequency-converted laser can be tuned from 2.85 to 3.1  $\mu\text{m}$  and from 1.62 to 1.71  $\mu\text{m}$ . It provides a power of 16 W at 3  $\mu\text{m}$  and 20 W at 1.6  $\mu\text{m}$ . The system is equipped with processing optics consisting of a galvanometric scanner and an F-theta objective lens and is available for material processing tests with MIR radiation.

### Applications

A relevant example for this application is the pre-treatment of CFRP component adhesive surfaces in the automotive and aerospace industry at a wavelength of > 3  $\mu\text{m}$ .

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