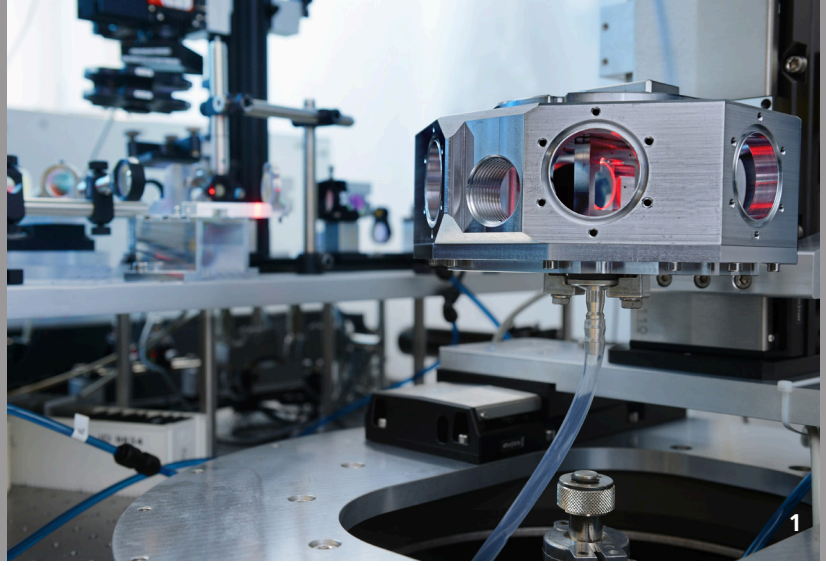

LIDT MEASURING STATION FOR THE QUALIFICATION OF HIGH PERFORMANCE OPTICAL SYSTEMS

Task

Understanding the laser-induced damage threshold (LIDT) of optical components is essential for the design of efficient yet reliable laser beam sources, especially when they need to be used in aerospace applications. For the Franco-German MERLIN satellite mission – to detect methane in the Earth's atmosphere – Fraunhofer ILT is conducting LIDT measurements on representative samples (so-called "witness samples") from each manufacturing batch. The measurements are used to qualify the optical systems before they are installed in the MERLIN laser.

Method

The laser source of the LIDT measuring station is a Q-switched, longitudinal single-mode oscillator with two INNOSLAB amplifier stages using up to 500 mJ pulse energy at 1064 nm or 100 mJ at 1645 nm from a downstream frequency converter. The online destruction detection system, which uses scattered light detection, works independent of wavelength. In addition, offline detection uses differential interference contrast microscopy. Fraunhofer ILT conducted S-on-1 tests for the more than 150 different coating samples of the MERLIN laser according to ISO 11254-2 with 10,000 shots and a pass/fail test with 100,000 shots, each with defined fluences per irradiation position. For the coordinated qualification process, the institute tests the specimens at approximately 40 positions, depending on the specimen size. The angle of incidence of the test radiation is 0°, 45° or 55°, depending on the batch specification.

Results

The combination of S-on-1 and pass/fail tests was used to investigate whether the laser-induced damage threshold is higher than the load in the laser in the long term. Tests on representative samples are used to qualify batches of optical systems before they are installed in the MERLIN laser.

Applications

The laser-induced damage threshold is relevant for optical systems that need to fulfil special reliability requirements, such as in aerospace applications. In addition, accurate knowledge of the damage threshold helps engineers adapt designs of optical systems to make them less expensive and more reliable. When the setup is extended, other test parameters, such as other wavelengths or pulse durations, will be available for testing.

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1 LIDT test setup.