



## PACKAGING



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### Fraunhofer Institute for Laser Technology ILT

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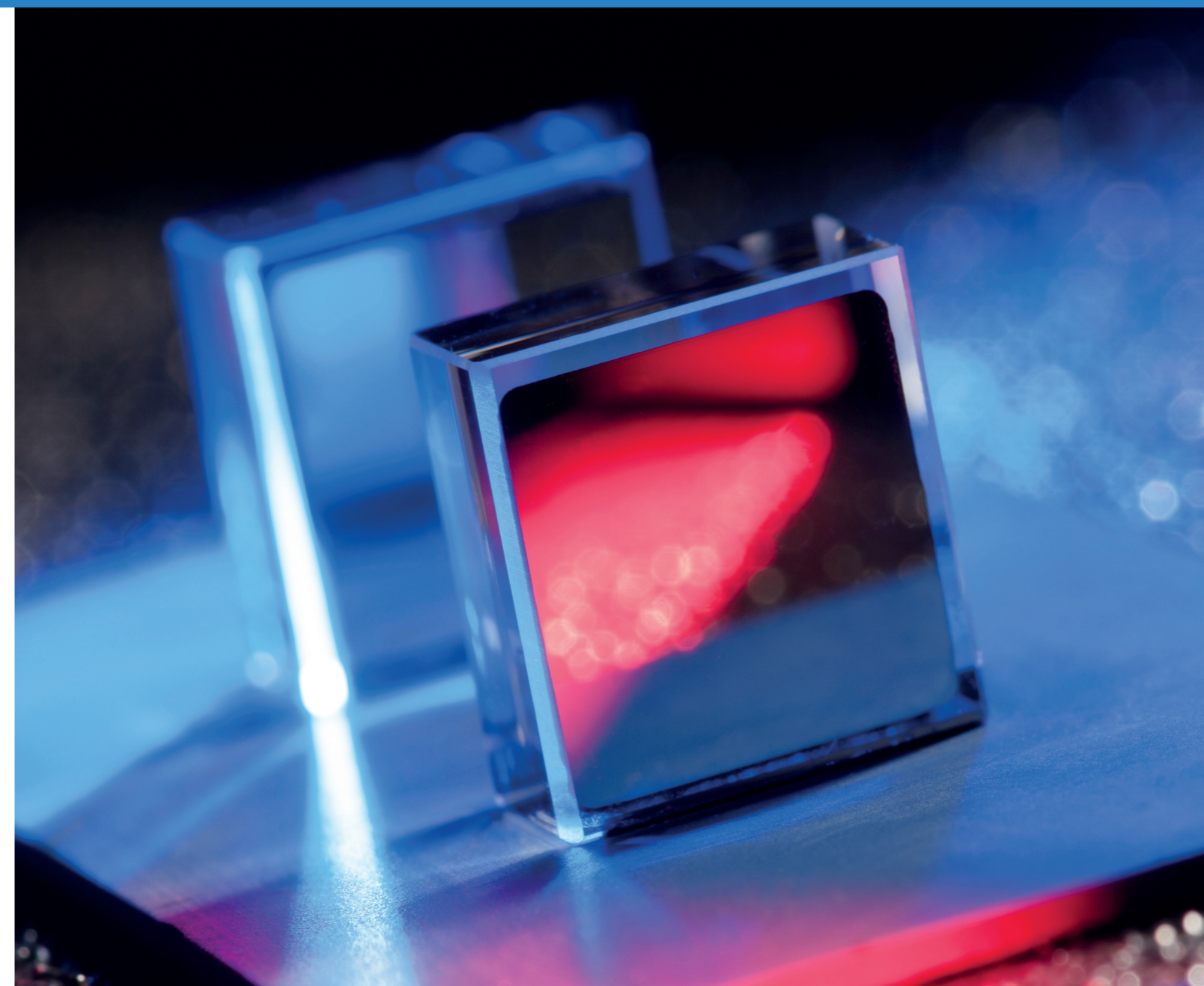
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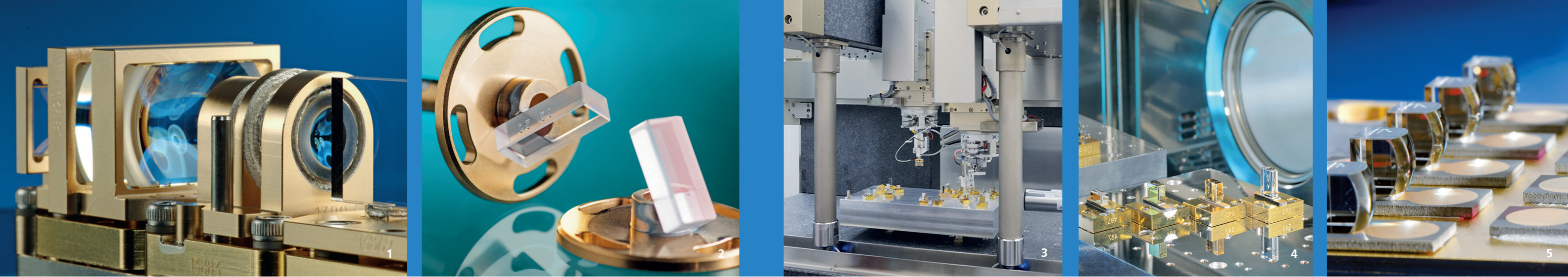
### Fraunhofer Institute for Laser Technology ILT

The Fraunhofer Institute for Laser Technology ILT is one of the most important development and contract research institutes in laser development and application worldwide. Its activities encompass a wide range of areas such as developing new laser beam sources and components, laser-based metrology, testing technology and industrial laser processes. This includes laser cutting, ablation, drilling, welding and soldering as well as surface treatment, micro processing and additive manufacturing. Furthermore, Fraunhofer ILT develops photonic components and beam sources for quantum technology.

Overall, Fraunhofer ILT is active in the fields of laser plant technology, digitalization, process monitoring and control, simulation and modeling, AI in laser technology and in the entire system technology. We offer feasibility studies, process qualification and laser integration in customized manufacturing lines. The institute focuses on research and development for industrial and societal challenges in the areas of health, safety, communication, production, mobility, energy and environment. Fraunhofer ILT is integrated into the Fraunhofer-Gesellschaft.







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The Fraunhofer Institute for Laser Technology ILT develops precise, reliable and robust optomechanics for demanding optical systems and laser-beam sources in industry and research. Based on the requirements of the overall system, the institute derives tailor-made components and interfaces and verifies the suitability of the installed systems by conducting analyzes and tests. Its complex laser arrays are based on qualified solder alignment techniques and are suitable for many applications – from industrial production to satellite-based atmospheric research.

### R&D Services

Fraunhofer ILT develops packaging solutions that make it possible to build high-precision and robust optomechanical systems, especially for laser-beam sources. For industrial applications, especially in the field of aerospace, our scientists optimize and qualify optomechanical components and arrangements with regard to their thermomechanical robustness, compactness or cost. The R&D services offered encompass the development of thermo-optomechanical designs and joining techniques, shear, temperature and vibration resistance testing, as well as the construction of complex prototypes.

### Design Development

When designing thermally and mechanically stable optical components, Fraunhofer ILT uses different simulation tools. Among the most important are, for example, investigations on how thermal load cases occurring in component operation influences the positional fidelity of the optical elements.

*Cover: Non-metallized optics soldered with an induction process.*

*1 Optical assembly soldered with the reflow process.*

*2 Soldered polarizers of a Faraday isolator.*

Mechanical analyzes are also informative, with which the effects of vibration and shock loads on positions of the optics can be determined and the systems developed optimized. In the area of simulation, the institute also employs optical, electrical as well as modal analyzes.

### Processes for Assembly

Different methods make it possible to assemble a customized system depending on the task and complexity of the optical system to be built. From developing the alignment strategy to developing the assembly equipment, Fraunhofer ILT offers its customers comprehensive know-how and a broad spectrum of processes, such as:

- Thin-film processes for the generation of solder layers (PVD)
- Pick & Align processes for the active adjustment of optical components,
- Reflow soldering processes for tolerance-insensitive optics
- Soldering processes for non-metallized components
- Planar construction processes
- Gripper development

### Spectrum of Components

Starting with soldering processes that have been developed and qualified for the assembly of high-power diode lasers, a large number of optomechanical components and assemblies can be joined – reliably, robustly and emission free – such as:

- Laser crystals with passive and active cooling
- Non-linear crystals such as BBO, KTP, LBO, TGG for Pockels cells, nonlinear converters and isolators
- Lenses and lens groups with low accuracy requirements for imaging systems
- Mirror and lenses of high accuracy classes with active alignment
- Fiber components
- Optomechanical assemblies, e. g. holders for lenses or mirrors
- Hybrid assemblies of glass, ceramic and metal using combinations of soldering and screwing techniques

### Quality Inspection

Thanks to its many years of experience in aerospace projects, Fraunhofer ILT has established a comprehensive methodology for quality assurance. This can include various measures, all depending on the application requirements. Using temperature cycle testing, the institute tests and validates component stabilities and functions are under extreme environmental conditions. In addition, it uses auto collimator measurements, vibration and shock tests and modal analyzes.

Shear and tensile tests are used to characterize a component's mechanical properties. In addition, it also has methods for material analysis or for metallurgical investigations at its disposal, such as energy dispersive X-ray spectroscopy (EDX) or scanning electron microscopy. For optical components, it can also measure characteristics for stress birefringence.

Fraunhofer ILT documents and stores all work steps in a database for the digital mapping of components, processes and machines within Industry 4.0.

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*3 System for high-precision assembly of optical components.*

*4 Optomechanical holders in a climatic chamber.*

*5 Optical components soldered with Pick & Align.*