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FRAUNHOFER INSTITUTE FOR LASER TECHNOLOGY ILT

LASERS IN PLASTICS TECHNOLOGY

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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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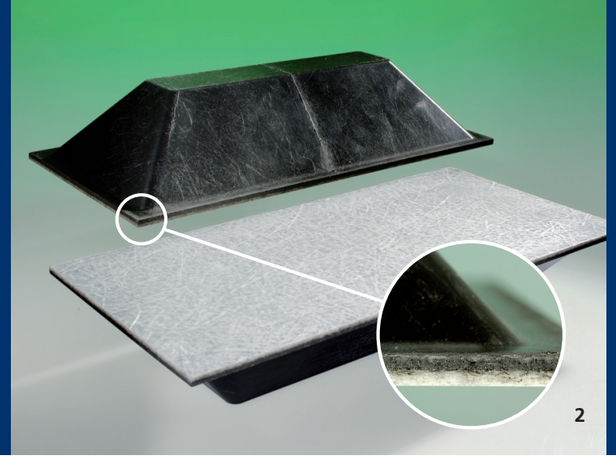
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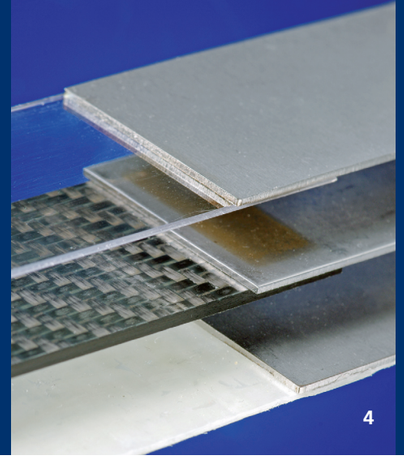
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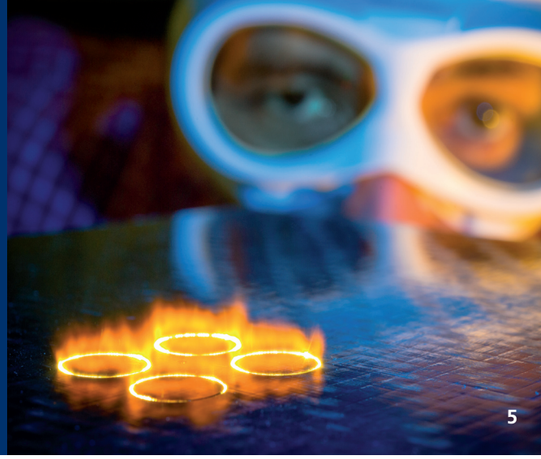
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LASERS IN PLASTICS TECHNOLOGY

Machining processes in the field of plastics technology have wide-ranging requirements. The Fraunhofer Institute for Laser Technology ILT has developed and qualified customized processes through to turnkey production systems for welding, cutting, drilling, structuring and marking of plastics.

Welding of Plastics

Laser transmission welding of plastics produces concealed joints with a minimal impact on the components. In this process laser radiation is transmitted through the first joining partner, with the energy absorbed by the second joining partner at the interface between the two. The plastic melts and joins the two components by means of heat conduction. Process development is closely linked to the material selection and the adapted energy deposition strategies. By carefully selecting laser source, beam shape and adapted irradiation strategy, users can join standard transparent and laser-absorbing plastics as well as other combinations.

Welding Transparent Plastics

When the laser wavelength is matched to the optical properties of the plastics, sufficient energy deposition can be achieved, even for optically transparent plastics without absorption enhancing pigments, which are frequently used in medical technology. Special focusing optics with a high numerical aperture allow the energy to be concentrated in the joining plane so that the threshold level required to melt the plastics is reached. The radiation intensity on the component's surface is so low that the laser does not damage the components.

Welding of Multilayer Films

Multilayer films are commonly used for packaging technology and the encapsulation of organic electronics. For film applications, which often require very high format flexibility, the use of laser radiation as a welding tool offers particularly key advantages compared to conventional tools with a fixed joining contour. Depending on the process requirements, laser transmission welding or gap welding can be used to connect the films. Moreover, multilayer film composites can be joined that contain barrier layers or metallic components as well as those made out of different plastics.

Welding of Fiber Reinforced Plastics

Laser beam welding can be used to manufacture complex composite fiber components out of several elements as well as to generate hollow structures. With this contact-free process closed reinforcements can be created, which increase component stiffness, as can local points of contact and joining elements to enhance component functionality without requiring complex process steps.

Plastic-Metal Joints

For reasons of cost and stability, lightweight components are generally made up of different materials. The ability to join plastics and metallic components is, therefore, becoming increasingly important. Laser microstructuring of the metal surface creates undercuts into which the plastic can flow in the subsequent joining process. In this respect, lightweight design potential can be leveraged extensively by joining appropriately pretreated metal with fiber-reinforced plastic.

Cutting, Drilling, Structuring and Marking

Thanks to its small heat affected zone and high process speed, the laser is an ideal solution for cutting, drilling, structuring and marking of polymers. Depending on the type of material, CO_2 lasers as well as solid-state lasers can be used. Based on process developments and qualification studies, industrial manufacturing equipment and components are being planned and built which will find their way into applications in the automotive industry, medical engineering, filter technology and packaging technology.

Process Control and Simulation

Process control and monitoring is indispensable for reliable high-performance manufacturing processes. Various pyrometric, CCD and thermal camera-based systems, which are integrated into the purpose-built optical processing head, provide process data for simulations aimed at understanding processes and optimizing their speed and quality.

Plastics Technology Equipment

- Fiber lasers with output powers up to 1000 W and wavelengths of 1075 - 1940 nm
- Diode laser modules with output powers up to 3000 W and wavelengths of 808 - 2250 nm
- CO_2 laser, λ = 10.6 µm, P = 200 W cw, fourfold pulse boost
- Various motion control systems, e.g. 6-axis robot and 4-axis-systems
- Machine for film-based roll-to-roll-applications
- Galvanometer scanner with focal lengths of 50 - 810 nm
- UV-VIS-NIR and FTIR spectrometer
- Process control systems
- Systems for non destructive component testing
- High-speed camera with 10 kHz frame rate
- Thermographic camera
- Universal tensile testing machine 10 N - 100 kN

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Front Page: Welding transparent plastic without IR absorber (PC).

1 Film-processing of biopolymers.
2 Cutting and welding of FRP hollow profile.
3 Welding of infusion tubes without IR absorber.
4 Combination of steel (1.4301) with different plastics (GFRP, CFRP, PC).
5 Cutting of fiber reinforced plastics (FRP).