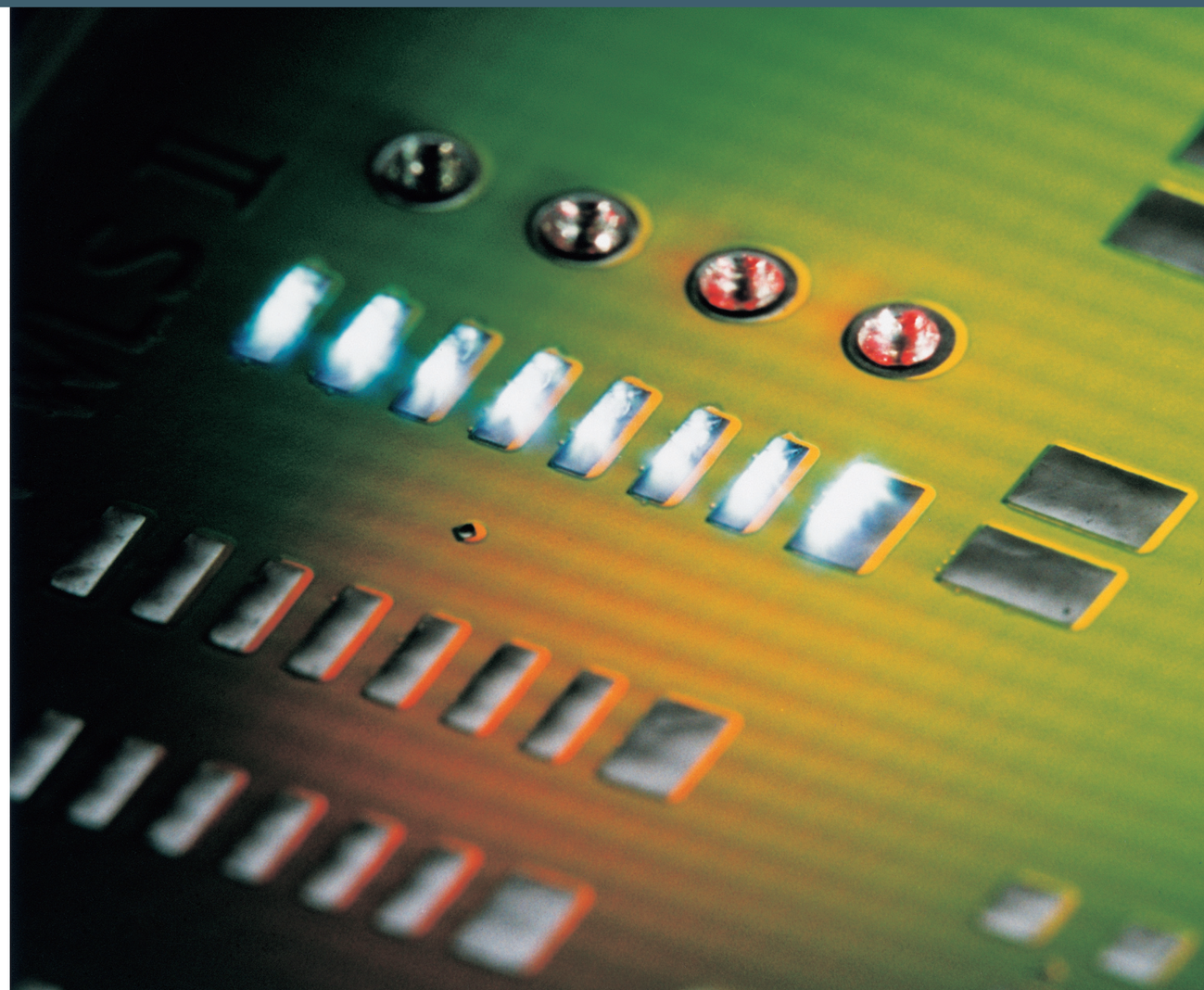
Fraunhofer
ILT

FRAUNHOFER INSTITUTE FOR LASER TECHNOLOGY ILT

LASER CLEANING



DQS certified by
DIN EN ISO 9001:2015
Reg.-No. 069572 QM15

**Fraunhofer Institute
for Laser Technology ILT**

Director
Prof. Constantin Häfner

Steinbachstraße 15
52074 Aachen, Germany
Telephone +49 241 8906-0
Fax +49 241 8906-121

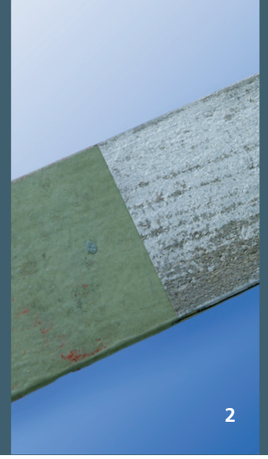
info@ilt.fraunhofer.de
www.ilt.fraunhofer.de

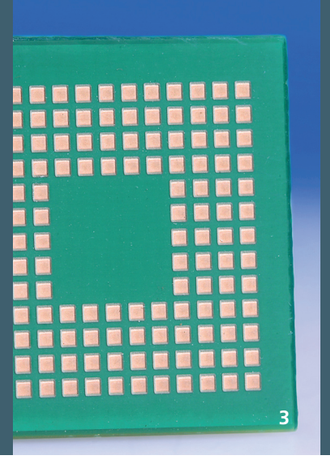
Fraunhofer Institute for Laser Technology ILT

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.

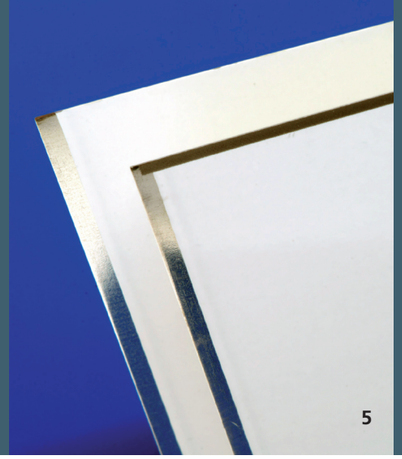
Overall, Fraunhofer ILT is active in the fields of laser plant technology, digitalization, process monitoring and control, simulation and modeling, AI in laser technology and in the entire system technology. We offer feasibility studies, process qualification and laser integration in customized manufacturing 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.

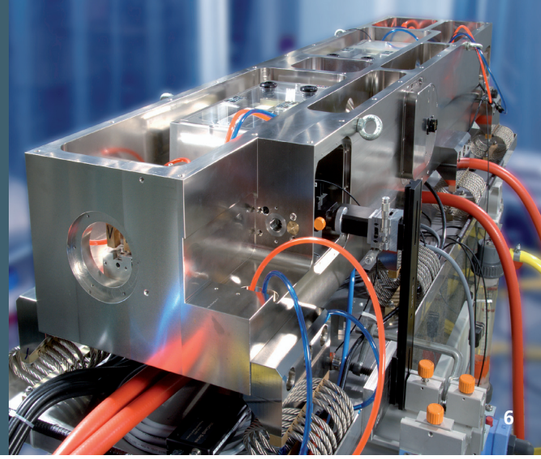
1


2


3


4


5


6

LASER CLEANING

The Fraunhofer Institute for Laser Technology ILT has been developing a new cleaning technique utilizing laser radiation to avoid secondary waste. This new challenging technique is environmentally friendly and opens up advantages in precision and speed. Using the laser cleaning method, large objects such as bridges and aircraft can be cleaned and prepared for protective coating.

The Process

The cleaning or removal is based on locally confined interaction of pulsed or continuous laser radiation with the surface layer. Depending on the laser wavelength, the intensity and the interaction time of the laser radiation with the surface layer, as well as the material properties, a thermal decomposition (e.g. evaporation, sublimation) or chemical reaction occurs.

Advantages

- High-precision removal of layers with thicknesses in the range from sub-µm to mm
- Selectivity of removal e.g. for cleaning sensitive surfaces or multilayer systems
- Contactless process without mechanical impact
- Low thermal and chemical load of the base material
- Ideal for automation
- Abrasive and chemical free
- Environmentally friendly, disposal of the removed material is all that is required

Systems Engineering

Fraunhofer ILT has a large range of laser sources, which operate in pulsed mode at pulse durations from fs to ns as well as in continuous wave (cw) mode. The output power of the sources ranges from some W to several kW. The wavelengths of the lasers used range from UV to IR. If there are no suitable commercial laser sources available, tailored laser sources with adapted characteristics are developed and qualified for the application by Fraunhofer ILT.

Depending on the geometry of the parts which have to be cleaned, the lasers are combined with standard processing and handling systems and/or very fast scanner systems, with processing speeds up to several m/s. Mobile systems have been developed specially for cleaning fixed objects (e.g. bridges, large steel constructions). If there are no standard beam deflecting and forming systems available, we can develop specially designed optics and beam deflecting systems, e.g. transformation optics for the generation of tailored beam shapes and high speed scanners with scanning speeds of several 10 m/s.

The resulting emissions are captured by an integrated suction system. If necessary, special-purpose suction nozzles can be developed to collect all emissions directly at the processing point.

Applications

Cleaning and removal can be applied to a wide range of combinations between surface layers and base materials. The technique can be used for large-scale cleaning as well as for cleaning locally well defined geometries down to the micro range.

If high cleaning rates are required, high-power Nd:YAG and CO_2 lasers (in the kW range) are used. Examples of these applications include the removal of carbon-black-filled elastomer layers from a colored elastomer base material, the cleaning of printing screens and the removal of epoxy coating powder layers from conductor rails. With laser power in the kW range, typical cleaning rates for layer thicknesses of several 100 µm reach several cm^2/s.

Examples of mobile applications include cleaning tools in assembled, hot condition and cleaning old weather-worn steel constructions (e.g. bridges, high-voltage pylons, large tanks and ships) before applying new corrosion-prevention coatings. The work is carried out with specially developed manually guided processing heads. Further mobile applications include cleaning airplanes and high-speed cleaning of rail heads, for which fiber-coupled laser sources working in pulsed mode with pulse durations of about 100 ns and average output powers of up to 1500 W are used.

Other applications include the removal of oil and grease as a pre-treatment before joining processes (e.g. welding, soldering and adhesive bonding), the descaling of metal sheets and the cleaning of printing rolls.

In the micro range the technique is used for the structured removal of lacquer layers before selective electroplating and oxide removal from copper as preparation for tin coating. Experience with laser cleaning in combination with new developments of laser sources and suitable system technology shows that high growth potential exists for this promising cleaning technique.

Contact

Dipl.-Phys. Carsten Johnigk
Telephone +49 241 8906-672
carsten.johnigk@ilt.fraunhofer.de

Dr. Jochen Stollenwerk
Telephone +49 241 8906-411
jochen.stollenwerk@ilt.fraunhofer.de

1 Service train with mobile laser system for cleaning rail heads.
2 Partially cleaned steel profile.
3 Precision cleaning of solder resist.
4 High-speed scanning opics with scanning speeds of up to 25 m/s.
5 Removal of PET layers from tinplate before welding.
6 Resonator of a fiber-coupled Nd:YAG-Laser with 1.5 kW output power for mobile applications.