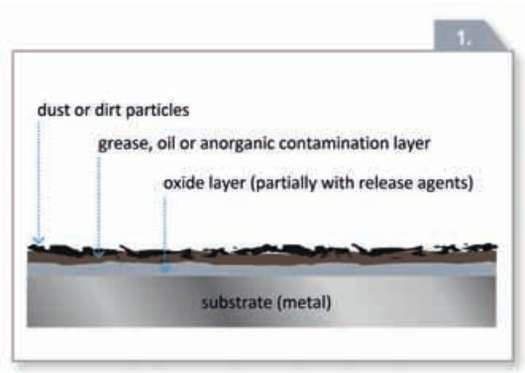
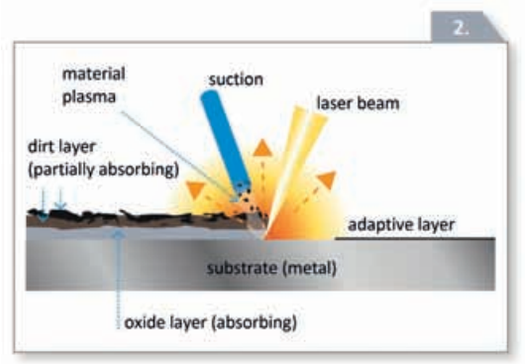
PRE-TREATMENT FOR ADHESIVE BONDING AND COATING

cleanLASER

Laser Pre-treatment of Metals





Cleaning and pre-treatment of the surface is an important prerequisite for a high-quality adhesive bond area.

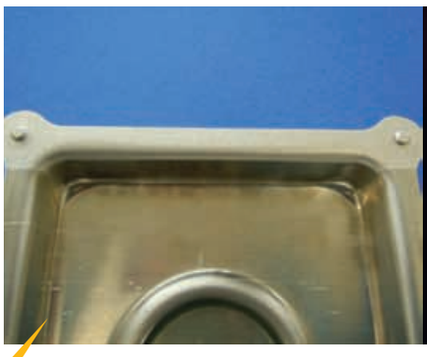
In the laser process only dirt particles, oxide layers and other contaminations are vaporized by bundled light only.

Laser pre-treatment leaves the metallic surface free of contamination and well prepared for bonding. The substrate is not damaged by the laser light. Metallic materials can be "modified" within the upper boundary layer using appropriately intensified laser parameters. This means the surface of the substrate can be enlarged respectively, modified to match the bonding mechanisms.

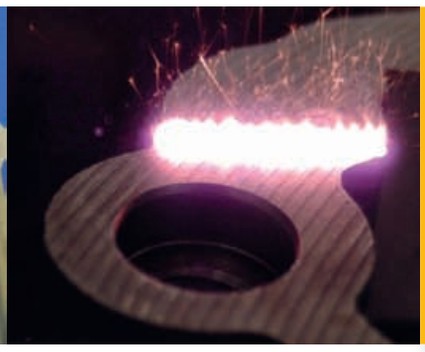
By targeted modification of the surface, the corrosion behavior of light alloys can be improved significantly. The substrate is resistant to age and environmental damage.

Application examples:

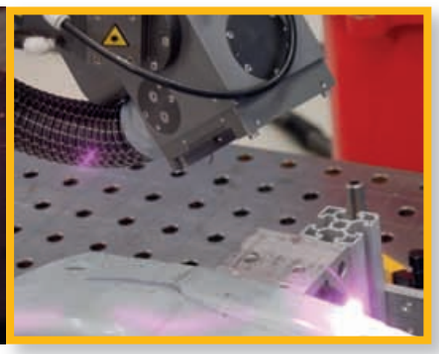
- Cleaning and degreasing of metals for adhesive bonding pre-treatment
- Conditioning of aluminum for long-term stable adhesive bonding
- Partial removal of coatings for precise adhesive bonding to metal or primer
- Structuring and modification of metallic surfaces
- Reproducible cleaning of sealing surfaces without changing the surface structure



Pre-treated flange of a deep-drawn part prior to adhesive bonding



Gentle cleaning of sealing surfaces



Precise degreasing with cleanLASER

FUNCTIONAL PRINCIPLE

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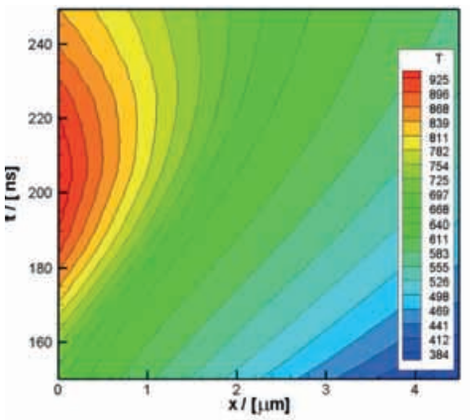
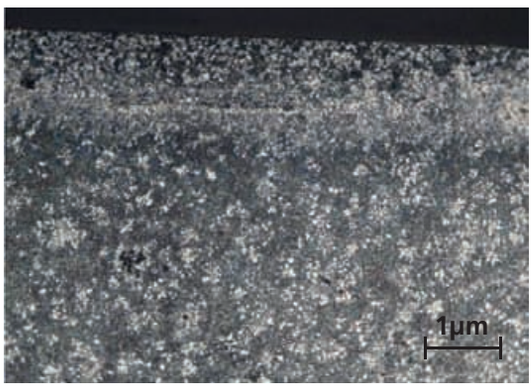
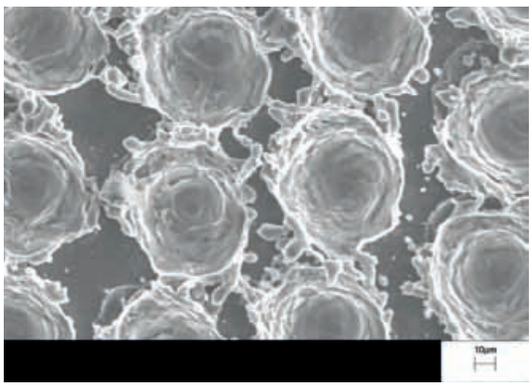
Ideal Preparation for Long-Term Stable Adhesive Bonding



Behavior of the surface temperature impacted by a single laser pulse during laser pre-treatment of aluminum: by fast remelting and cooling a near surface passivation layer is formed



The surface of the laser-cleaned light alloy part forms a microcrystalline respectively amorphous boundary layer, free of contamination and with decreased electrochemical potential



The aluminum surface microstructured by cleanLASER features an increased roughness and passivation by possible overall remelting of the surface and targeted placement of micro-porosity/melt craters

The laser light removes oxide layers including superficial contamination, e.g. from light alloy surfaces. The near-surface zone in the area of typically ~ 1 µm is remelted within a few nanoseconds, the melt quickly being cooled simultaneously.

By dissolving the grain boundaries and due to the heat capacity of the part a "quenching" occurs. This results in a new micro-crystalline amorphous and rough boundary layer (adaptive layer) with significantly decreased element corrosion behavior.

The modification processes is automatic when exposed to air without any protective gas. The new, passivation oxide layer on top of the melt forms a very stable bond with the adhesive. Combined with the decreasing electro-chemical potential of current aluminum and magnesium alloys this leads to long-term, age-resistant bonds.

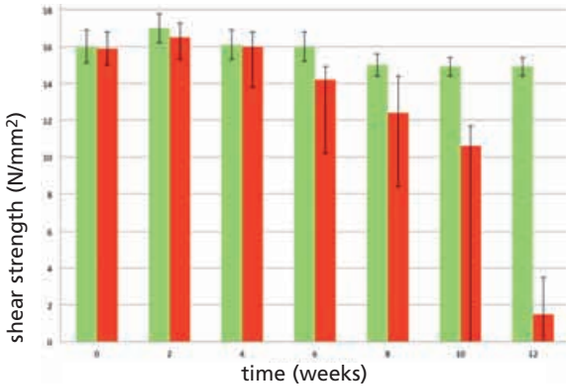
Short-term remelting leads to additional "micro-craters" that cause a significant surface enlargement and thus an increased load transmission particularly under shear load.

Further benefits compared to conventional technology:

- **Low running costs (usually less than 1 €/hr.)**
- **No consumable media and abrasives**
- **Low space requirements**
- **Easy automation and in-line integration**
- **Precise cleaning of partial areas: only the required areas need to be cleaned**
- **Environmentally friendly process with energy savings of up to 87%, awarded with**

Deutscher Umweltpreis 2010

Long-Term Stability



Behavior of the tensile shear strength according to DIN EN 1465 of epoxy resin bonded aluminum parts(6016)

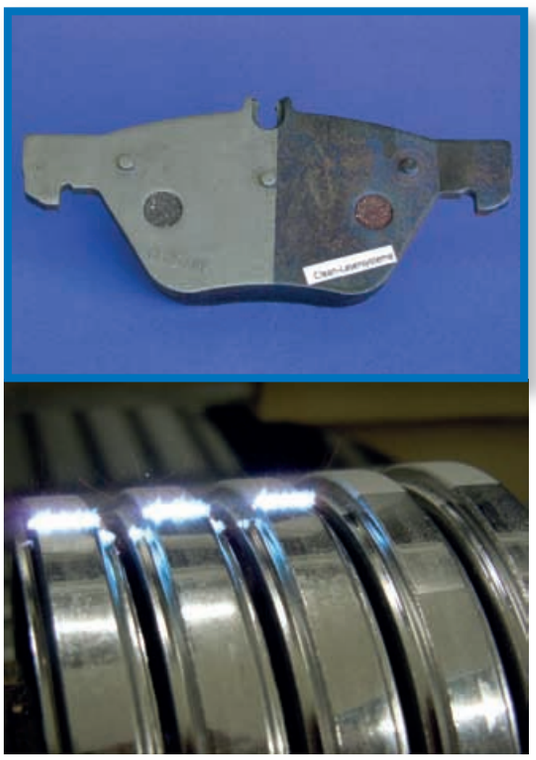
Within the scope of a multi-week alternating climate test according to VDA standard, a significantly lower weakening compared to conventional pre-treatment becomes evident.

Numerous scientific long-term tests have shown:

- 100 % repeatable, constant results by complete removal of original oxide layers and superficial contamination, e.g. cast skin with release agent residues
- Increased long-term adhesive bonding stability (weakening of tensile strength after 10 weeks of alternating tests according to VDA < 15 %, with cohesive fracture appearance)
- Pre-treatment and process monitoring in one process step possible
- Storable metal surfaces that can safely be bonded even several days after treatment
- Pre-treatment directly prior to bonding is possible (in-line)
- Processing speed / area rate: up to 30 cm²/s

COATING PRE-TREATMENT

Dust- and Particle-Free Process



Coating pre-treatment

The mechanisms of laser pre-treatment for coating are quite similar to those for adhesive bonding pre-treatment. Pre-treatment with laser light leads to an outstanding coating quality.

Another essential benefit is that neither dust nor particles, e.g. by dispersion of abrasives, will contaminate the surface. With cleanLASER-technology surface tensions of > 72 mN/m can be achieved. An optimum wettability is an important prerequisite for a good adhesive strength of the coating and thus a permanent protection against corrosion. In the area of coating pre-treatment high processing speeds are achievable.

Top: partially laser pre-treated brake pad (unit price approx. 1 cent per component)

Bottom: coating pre-treatment of aluminum rolls

DEVICE TECHNOLOGY AND PROCESS MONITORING

cleanLASER

Complete Solutions from one Source

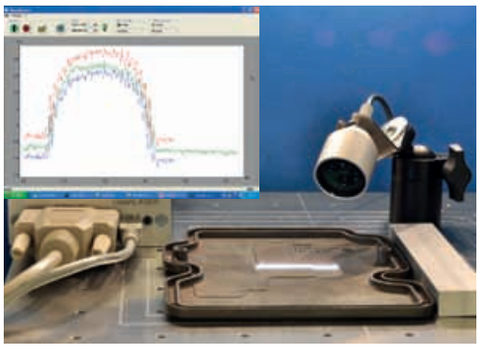
Modular laser system with two low-power laser systems

Laser Systems

The modular design of the 20 to 1000 Watt laser systems offers maximum flexibility. Depending on customer specifications, laser optics for adhesive bonding and coating pre-treatment are available as well as fully automated production cells or in-line integration as complete solutions.

Process Monitoring

cleanLASER has developed a simple, robust measuring system that determines the cleaning effect on the material surface or the dirt layer respectively. Plasma sensor use allows optimal tracking of the cleaning intensity on a machined surface and thus a 100% in-line monitoring and quality assurance without cleaning process intervention. We offer additional turn-key solutions for controlling laser process and parameters.



Integrated process control and monitoring with the plasma sensor cleanMONITOR

Pre-Treatment with Laser Light - Precise, Environmentally friendly and Long-Term Stability

cleanPOINT: high intensities for precise adhesive bonding pre-treatment of rotating parts

shareMOTION optics for processing tong-and-groove geometries

The cleanCELL manufacturing cell for processing parts with three-axis linear motion system

The protection cover of the safeBOX adheres itself to the surface of the part

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