



LASER-BASED TREATMENT OF METALLIC SURFACES FOR INCREASING ADHESION

Task

By using composites or multi-material coatings, the industry can meet the increasing demands placed upon workpieces and components in terms of corrosion and wear protection. The issue here – the adhesion between the respective layers – constitutes a central challenge, especially for adhesive bonds or metal-plastic bonds. The pre-treatment of a joining partner with pulsed laser radiation is a promising approach to improve adhesion without functionally deteriorating the base material.

Method

For the laser pre-treatment, pulsed laser radiation of wavelength $\lambda \approx 1 \mu\text{m}$ is guided by means of a 2D or 3D scanner system in a meandering or unidirectional pattern across the workpiece. Typical pulse lengths are in the range of 5 - 100 ns at repetition rates of several kilohertz to one megahertz. To characterize the surfaces, Fraunhofer ILT uses scanning electron microscopy, white light or energy dispersive X-ray spectroscopy. The wetting behavior can be examined by means of contact angle measurements for temperatures up to 700 °C.

Result

Thanks to site-selective energy deposition and the short interaction times, the surface of the workpiece can be modified without a functionally relevant thermal effect, among others, on the base material. For metallic workpieces (e.g. aluminum or steel), the modifications include, in particular, chemical changes (e.g. oxidation) and changes in the surface topography. Typical lateral structure sizes are between 10 μm and several 100 μm .

Applications

This process can be applied where composites and multi-material layers are used. The polymer coatings generated with this process, under the project »RESKORR«, sponsored by the Federal Ministry of Education and Research (grant number 03X3564F), were made on bearing steel. Their adhesion could be improved thanks to laser pretreatment on substrate.

Contacts

Hendrik Sändker M.Sc.
Telephone +49 241 8906-361
hendrik.saendker@ilt.fraunhofer.de

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

- 3 SEM image of untreated (l) and laser pre-treated (r) surface of a workpiece out of bearing steel.
- 4 Wetting on an untreated and laser-pretreated surface.