

**BUSINESS UNIT  
THERMAL SURFACE TECHNOLOGY**

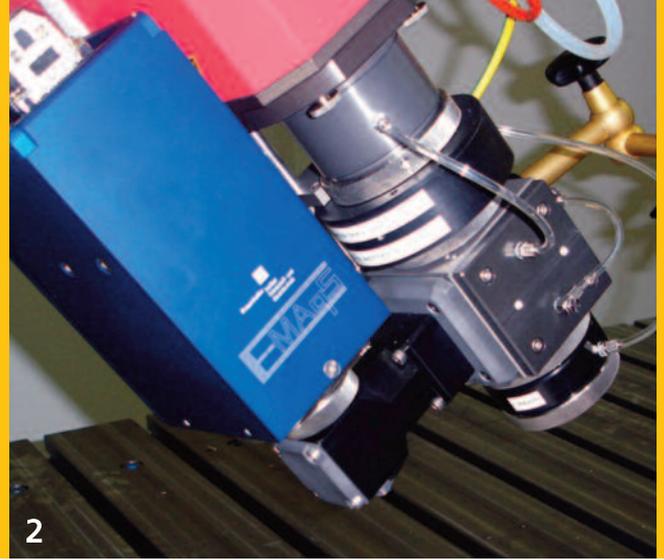


**DRESDEN**





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# INTERACTION BETWEEN MATERIAL, PROCESS AND SYSTEM TECHNOLOGY

The business unit Thermal Surface Technology at the Fraunhofer IWS Dresden focuses on the following core fields:

- laser surface heat treatment (focus on martensitic laser hardening of surfaces)
- laser cladding (direct material application with powder and wire for component property improvement and repair)
- thermal spraying (coating and functionalization of surfaces with metallic and ceramic materials)

## Scientific basis

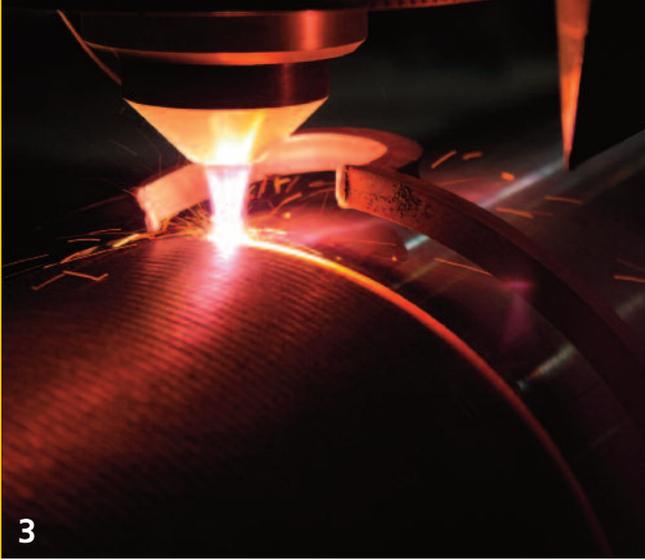
- analysis of microstructures and properties of metallic materials and development of material, stress and component-determined treatment strategies
- characterization of the influence of material, coating technique and coating parameters on the resulting properties of the component
- development of process and component adapted test equipment and system technology

## Trends

In the field of laser surface heat treatment, research is focussed on new low-cost methods for wear and fatigue protection, especially for modern material systems, for which conventional surface treatment processes are not applicable.

Wire-based laser cladding provides a "clean" and economical complement to powder-based processes. With the system technology (modular wire head) and process monitoring developed at the IWS, automatable processes for the production of high quality coatings and 3D build-ups are available.

The system technology for spraying with suspensions developed at the IWS offers coating solutions for various applications for wear, corrosion and oxidation protection as well as insulation, including sensor and thermoelectric functionalities.



## OUR EXPERTISE

### Laser surface heat treatment

For component geometries, wear cases and materials for which conventional hardening technologies fail, laser surface technologies offer many new solutions for producing wear-resistant surfaces. Main research areas are laser hardening of steels and laser induction roll plating to create complex mixed metal joints. Furthermore, we offer special technical solutions for soldering, remelting and gas alloying. The core competence of the IWS herein is the development of procedures and the elaboration of customer specific processing concepts, as well as the new and further development of the system technology, ranging from individual devices to complex machines and systems. Developments are focussed on the realization of precise temperature control systems to provide the basis for reproducible industrial processes.

### Laser cladding

This field of expertise includes the use of laser cladding with wire and powder for coating surfaces, generating improved functionalities in the surface region and the repair of components. For this purpose, the Fraunhofer IWS develops innovative processes and system technology for a large number of different combinations of base and filler materials. An important focus in this case is represented by the user-specific development of laser processing heads and component technologies and the application and integration of advanced CAM software.

### Thermal spraying

For coating and functionalization of components made of steel, lightweight metals, ceramics or other materials with metals, hard metals and oxide ceramics, atmospheric plasma sprayings (APS) and high velocity oxygen fuel (HVOF and HVAF) spraying technologies with powders and suspensions are available at the IWS. Current priorities in the field of thermal spraying are the development of new spraying technologies, system components and coating solutions (e.g. laminate heater elements, thermoelectric modules, hard metal layers for highly stressed components), as well as the characterization of layers. In the field of suspension spraying, system components (for example, injectors and suspension feeders) designed to be integrated into new and existing installations, are developed.

- 1 *Laser hardening of a steam turbine blade*
- 2 *Camera-based temperature sensing system "E-MAqS" for laser hardening and laser cladding*
- 3 *Process of inductively supported high power laser cladding with a modern coaxial head*
- 4 *Thermal spraying with suspensions*



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## HIGHLIGHTS

In recent years, a variety of systems for **laser hardening** could be transferred to industrial applications, e.g.:

- laser hardening of inner seats of injection modules for modern diesel car engines (approximately 9 million pcs. per year)
- annealing-free zone laser hardening of sliding bearing seats of lorry turbochargers (universal hardening plant, about 90 different part types)
- robotic laser hardening in tool and mould manufacturing (plants in Germany, Switzerland, Italy, Slovenia)
- laser hardening of very large forming tools (hardness portal, integration into Sachs milling portal)
- laser hardening of hydraulic components (partial integration in automatic bar lathes)
- laser hardening of steam turbine blades (using laser-hardened turbines in more than 180 power plants worldwide)

In the field of **laser cladding**, the Fraunhofer IWS can prove over 120 industry transfers with specific solutions. The IWS develops for German and international customers and for a variety of applications, e.g.:

- repair of engine and gas turbine components (Germany, Spain, Italy, Poland, Sweden, China)
- repair of moulds and tools (Switzerland, Austria)
- laser cladding on aircraft engines (Portugal)
- laser cladding on automotive components (Germany)
- coating of large components for the energy industry (UK)

Concerning **thermal spraying**, the IWS has achieved a high international reputation in a short time. In joint research projects with industry, component and coating developments and system developments for suspension spraying are promoted. Recently, a suspension feeder could be marketed.