Laser Surface Modification

Laser Processisng Research Center , Soochow University

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Laser Processing Research center,Soochow University provides:

- **Laser cladding job shop services**
- **Laser cladding systems**
- **Laser cladding research & process development .**
- **Laser Processing Research center,Soochow University** offers specialized laser process development and laser research services. Our in-house engineering team is devoted to providing solutions for laser machining problems, including system development and process development for laser cutting, welding, etching, heat treating, and cladding.

Laser Surface Modification

Laser Surface Modification is widely used to alter the surface of a component to improve the part's ability to withstand harsh environments. The primary laser-based surface modification operations that can be carried out at CLPM are

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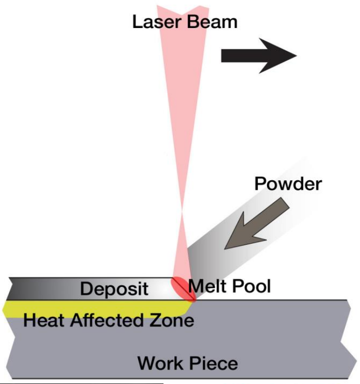
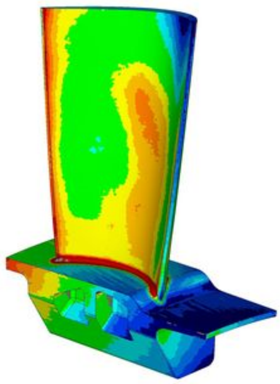
Laser Cladding



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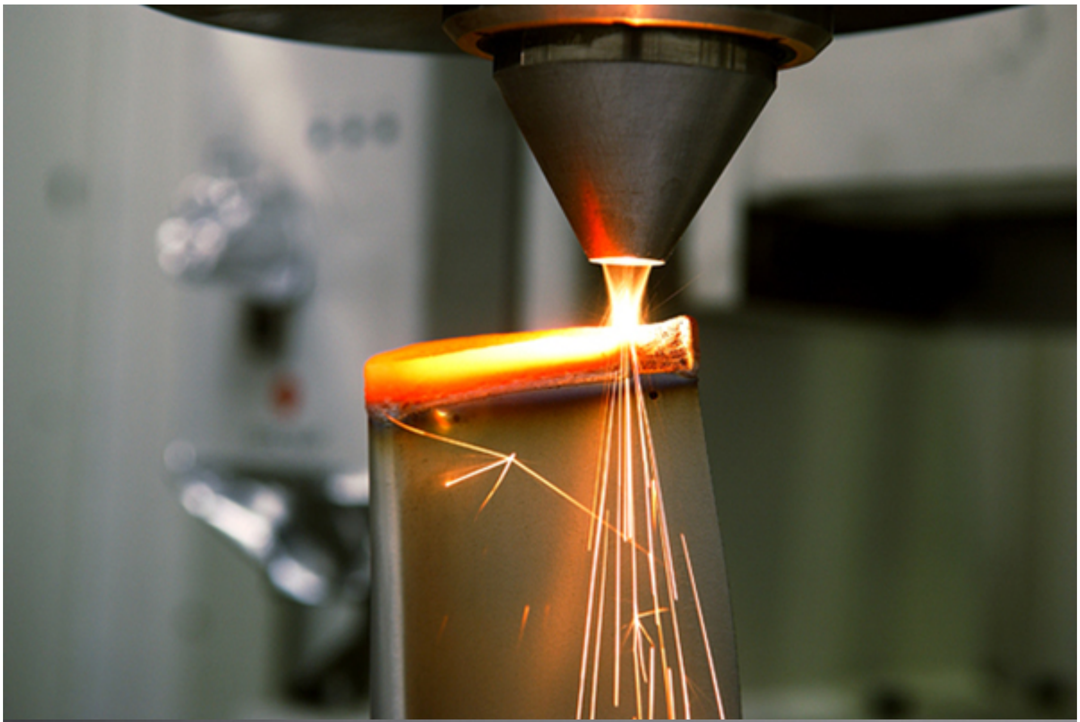
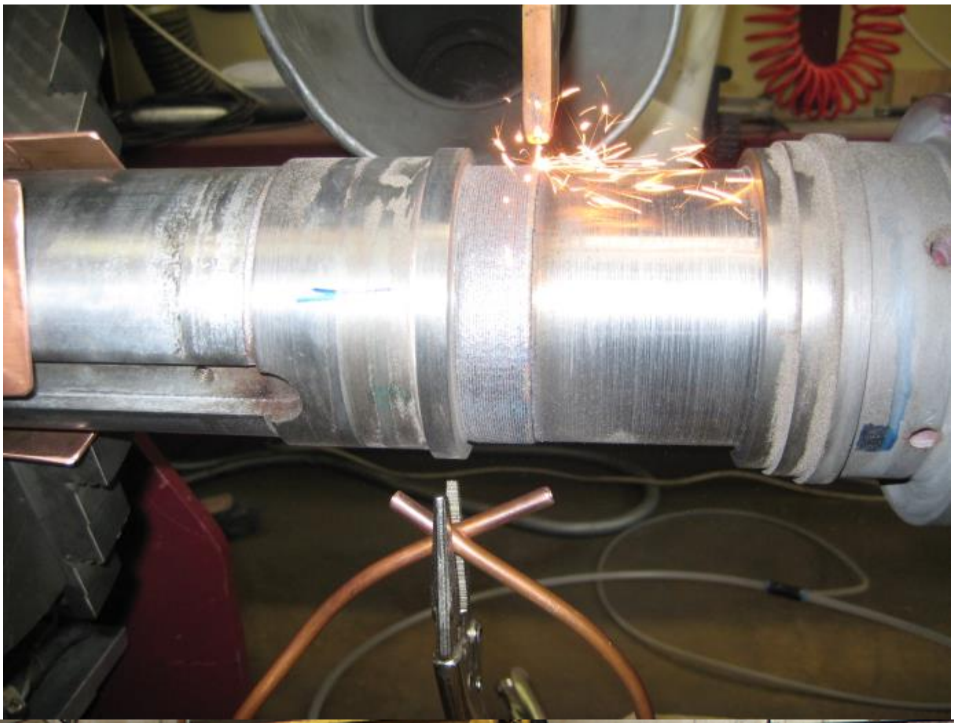
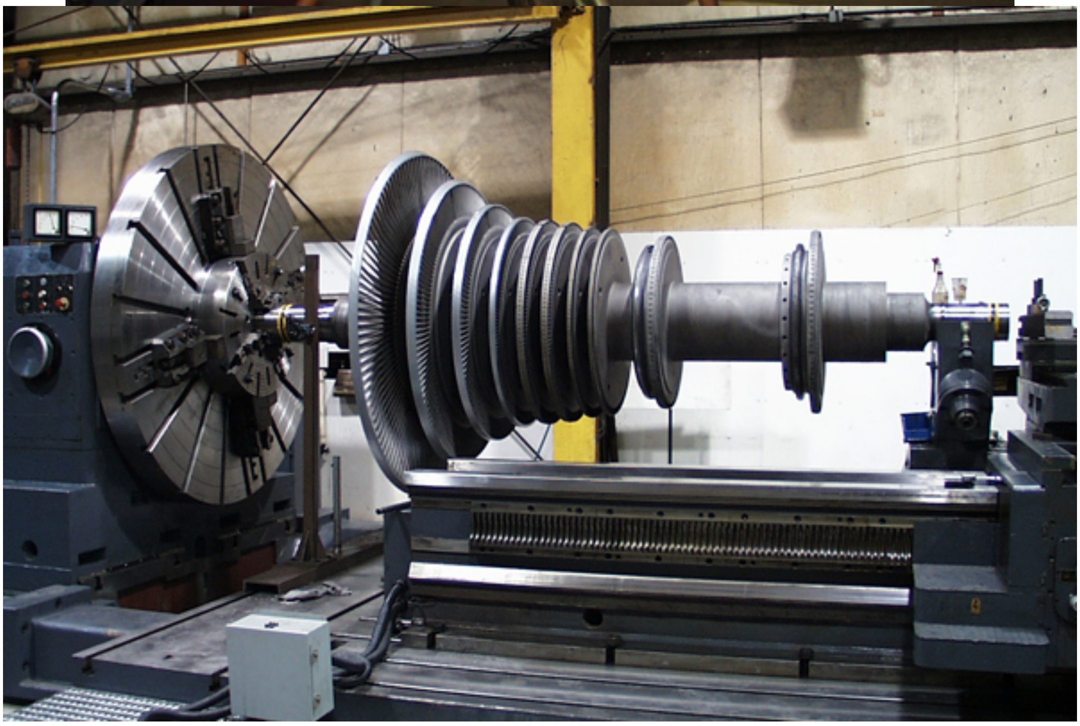


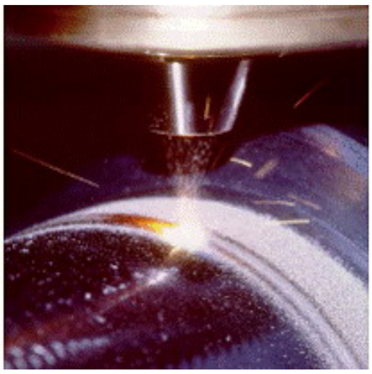




The ability of a laser to yeild high power densities on a surface and generate heat can be successfully utilized for cladding applications. The controlled power density allows a metal to be fused onto another metal with minimal thermal input. Appropriate tailoring of the surface properties by using suitable cladding materials increases the component's wear and corrosion resistance. In many instances, the properties of the clad substrate material composite are unique and cannot be obtained in any other manner regardless of cost. A wide range of materials can be clad enabling virtual tailoring of surface properties to meet any given requirement.

The clad powder is typically delivered by blown powder technique. The Centre is equipped with two powder feeders (METCO 4MP & indigenously fabricated fluidized bed powder feeder) which can be utilised for efficient deposition of powders for a variety of cladding applications employing the 10 kW CO_2 laser. An R & D project involving laser cladding of Oil company is currently going on.

Laser Surface Alloying



The process of laser surface alloying (LSA) is similar to surface melting with the laser except that desired alloying elements are extraneously added to the melt pool to alter the surface chemical composition as best suited for the part being treated. Such modification of the surface composition to achieve the desired properties can be effected by introducing the alloying elements in gaseous or powder form as a prior coating. Thickness of the alloyed layer can be up to 2000 μm.

LPRC is currently carrying out sponsored R& D studies on laser surface alloying of borides in collaboration with XXX University, China.

Laser Heat-treatment

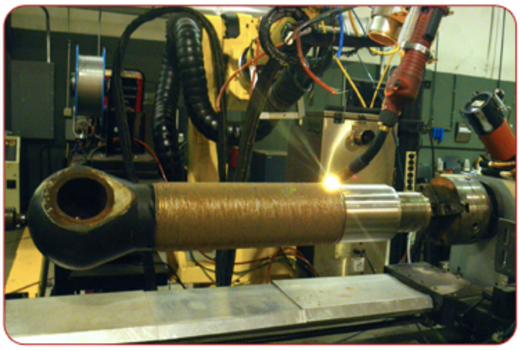
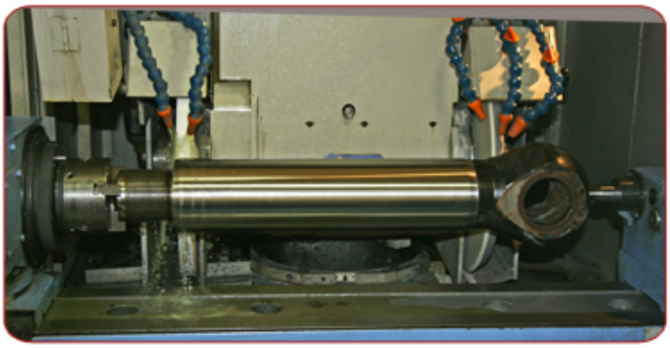
Laser hardening and surface remelting are widely used to improve the mechanical properties of highly stressed, ferrous machine parts. Surface hardening increases wear resistance and fatigue life through microstructural changes induced in the metal surface during processing. The depths of the hardened layer are typically 0.1-0.2mm, and hardness values in the range of HV 490 to 820 can be achieved. Generally, no quenchants are required. Output beams are easily shaped by optical components into square, circles, lines or into more complex axi-symetric shapes for special purposes. This makes it easy to heat treat not only flat surfaces, but also such machine parts as bearing races, gears, shafts, cylinders, camshafts and the like.

Laser Induced Surface Improvement (LISI):
Basics of Implementation

- select a property improvement (i,.e. wear, corrosion, erosion, lubricity, etc.)
- select a base alloy
- design an alloy surface that provides the improvement
- form a master alloy powder blend and apply it to the surface of the base alloy as a paint or thin film
    - master alloy layer ~ 100-200 microns
- apply thermal energy via laser optics to melt the master alloy addition into the top layer of the base material
    - laser optics optimized to achieve uniform heating
    - laser optics dwell time very short, permitting rapid cooling and formation of refined grain, non-equilibrium structures
    - new alloy depth into base metal variable from 25-1000 microns
    - fiber-optic laser beam delivery permits precise control of location

Laser Induced Surface Improvement (LISI)

- Refined laser surface alloying
- Improved optics for flat beam profile
- Additive metallurgy process
- Uniform surface with low HAZ
- Full metallurgical bond with substrate

Shaft with damaged ceramic coating;Shaft after ceramic coating has been removed and laser cladding has begun;Shaft during finish grinding.

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