Fraunhofer IWS

Laser Direct Plating

High-Performance Coating for Rotationally Symmetric Components

Laser direct plating enables energy-efficient coating of rotationally symmetric components using strip-shaped material applied directly from the solid phase. This process significantly reduces energy consumption and achieves deposition rates of up to 100 kilograms per hour. Initial applications demonstrate its potential for refurbishing work rolls and coating large hydraulic cylinders and bear-ing shells.

Challenge

The increasing share of renewable energy sources and the demand for sustainable technologies are driving the need for resource-efficient and energy-saving manufacturing processes. Conventional coating methods reach their limits when it comes to large-scale components – particularly in terms of energy consumption, achievable coating thickness, and deposition rates. These traditional processes often induce high thermal loads and require extensive post-processing, which negatively impacts both cost-effectiveness and environ-mental sustainability.

Solution

In laser direct plating, a strip-shaped material replaces powder- or melt-based feedstocks. A laser locally heats the material within the joining gap with minimal energy input, while a pressure roller bonds the strip metall-urgically to the component in a spiral pattern. This results in a homogeneous coating with significantly reduced thermal stress. Deposition rates of 50 to 100 kilograms per hour can be achieved. At the same time, production costs are lowered due to a fivefold reduction in energy consumption, full material utilization, and minimal post-processing requirements.

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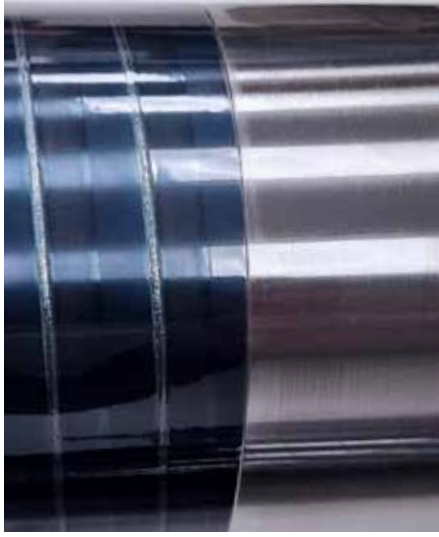

Advantages of the Process

- 100 percent material utilization
- Reduced post-processing thanks to high surface quality directly after deposition
- Lower energy consumption compared to alternative coating methods
- Extremely high deposition rates up to 100 kg/h
- Low thermal load on the base component
- High coating homogeneity
- No overspray

Technical Data of the Pilot System

- Dimensions of blanks/base components: Ø 80–400 mm, up to 2000 mm length
- Final part dimensions: max. Ø 500 mm
- Component weight: up to 2.5 tons
- Coating material: Metal strips, 5–22 mm wide, up to 3 mm thick
- Materials: Stainless steels (e.g., 316 L, 1.4401), bronzes, brass, copper, nickel- and cobalt-based alloys

Left
Pilot system for laser direct plating at Fraunhofer IWS.

Center
Demonstrators: Unalloyed structural steel 1.0305 coated with DC-04.

Right
Detail: Coating with post-processing.

Industrial Applications

- Refurbishment of work rolls
- Coating of large hydraulic cylinders
- Direct application of bearing materials

Example: Coating of a Hydraulic Cylinder Tube

Length: 18 m | Diameter: 0.4 m | Coating thickness: 1.5 mm

	New: Laser Direct Plating	Conventional: Laser Cladding
Coating time	**6.3 h**	20.9 h
Deposition rate	**43 kg/h**	12.8 kg/h
Energy consumption	**125 kWh**	1,047 kWh