

Laser Cladding in 3D

Using high-power lasers and modern multi-axis handling systems, laser cladding systems from Metco Joining & Cladding can precisely place deposits on surfaces and edges. These systems can employ CAM software tools to use 3D CAD models to produce the desired product.

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Compared to conventional welding build-up processes such as PTA, laser cladding has significantly lower and more localized heat input, low dilution of the substrate material and reduced potential for distortion. Thus, it offers advantages in terms of the materials that can be deposited and the workpiece geometries that can be processed. Even materials that are difficult to weld, such as high-temperature nickel-based alloys and high-carbon steels, are more easily clad using laser cladding. In addition, the typically small melt pool formed during laser cladding gives enables processing of very complex geometries within a single setup to deposit protective surfaces, restorative build-ups and the creation of near-net shapes.

3D cladding origins: considerations from the milling process

The production of impellers, whether from an open design with a brazed or welded shroud, or integrally milled from a blank, is one of the core manufacturing competencies of Metco Joining & Cladding. This is accompanied by many years of experience in the programming of 5-axis, simultaneous

milling processes, using both commercial CAM software and techniques developed in-house.

Metco Joining & Cladding operates, amongst other laser cladding systems, a gantry robot with a 2 kW CO₂ laser and a 1.5 kW fiber-laser system, both of which support 5-axis simultaneous machining. The idea

of depositing build-up cladding tracks instead of milling tracks was thereby just as obvious as the first area of application — the restoration of the exhaust gas turbocharger blade tips.

3D repair welding

In 5-axis simultaneous machining, the tool, which would be the milling cutter in a milling machine or the laser beam and the powder nozzle in a laser cladding system, can be continuously moved over the

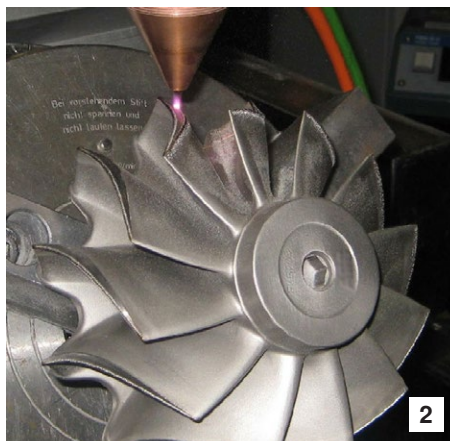
surface of the component on various programmed tracks at any angle of incidence. In the laser cladding process, the laser beam is ideally mounted perpendicular to the workpiece.

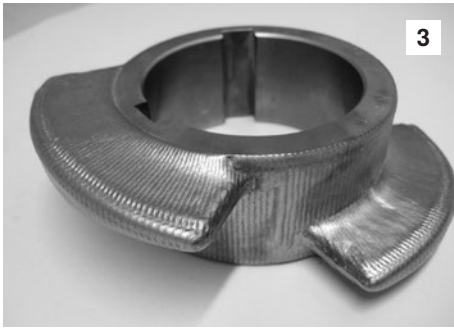
In the exhaust gas turbocharger example, sufficient material is deposited onto the curved surface of the turbine blade using the laser, and the original geometry is then restored by grinding or milling. The cladding deposit tracks are generated on the basis of the CAD model available in the CAD system.

A robust cladding strategy is just as important as robust cladding parameters in order to compensate for the geometric deviations of the cast wheel. In addition, a coaxial powder nozzle is used, with which a homogeneous build-up deposit can be realized, regardless of the cladding direction [2]. Large, heavy workpieces that cannot be placed on a rotary-tilting table can be processed either with the gantry robot CO₂ laser system with two swiveling axes for the processing head or with the new 10-axis Metco Joining & Cladding MetcoClad™ system, powered by a 6 kW diode laser [1].

Component armoring for wear and corrosion protection

The application of wear protection deposits to the curved surfaces of a feed screw [3] is an interesting area of application. Using a multi-axis laser cladding system to deposit a material such as MetcoClad 6 — a hard, corrosion-resistant cobalt-based alloy — combined with carefully selected cladding parameters and a robust cladding strategy, ensures complete, crack-free coverage of the exposed surfaces. Even sharp edges, such as at the transition of the feed screw blade at the hub, can be handled with





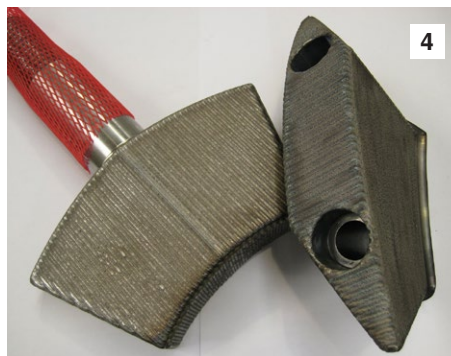
minimal pause of the process between cladding tracks. Here too, programming the cladding tracks in the CAD system is advantageous.

Rock crusher teeth [4] exposed to impact and erosion can be completely armored with a deposit of tungsten carbide in a cobalt or nickel matrix. These teeth can be protected in a single laser-cladding setup using welding tracks previously defined in the CAD system [5]. Compared to hardfacing these teeth with manual welding processes, the process time is considerably less and the weld quality, i.e., the wear resistance of the coating, is significantly better.

Metco Joining & CladdingClad Services, Systems and Materials

Metco Joining & Cladding has more than 20 years of experience in laser cladding using a wide-range of deposit materials on an equally wide variety of substrates. Thus, customers coming to Metco Joining & Cladding for laser cladding services can be assured of reduced development and process

qualification times for new applications. More recently, Metco Joining & Cladding offers multi-axis robotic laser cladding systems that incorporate the company's long-standing application know-how and a growing portfolio of materials designed for laser cladding for customers who wish to process in-house. Here, customers can be assured of a reliable supplier as a result of Metco Joining & Cladding's decades of materials expertise in the development of thermal spray and hardface welding materials, as well as their well-known experience in the design of robotic systems for thermal spray.



About Metco Joining & Cladding

Metco Joining & Cladding is a leading brand for joining and cladding solutions, including welded overlays, brazing, laser cladding and plasma transferred arc. Since 1970, our experience has benefited customers with a customizable and comprehensive solutions portfolio of materials, ranging from powders, wires, rods, electrodes, braze pastes and braze tapes, designed to serve the critical needs of industries, such as aerospace, power generation, mining, oil and gas and agriculture. With a global footprint, Metco Joining and Cladding can offer deep expertise and solutions, also in combination with our broad range of materials, in close proximity to customers. The Metco Joining & Cladding brand is owned by the global Oerlikon Group (SIX: OERL), headquartered in Switzerland.

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