Fraunhofer IWS

COAXwire mini

Laser Wire Cladding with Highest Precision

Laser cladding with wire is an efficient and resource-saving method for surface treatment and additive manufacturing of parts. Existing systems are designed for standard wires with a diameter of 0.8 to 1.2 mm and laser spot dimensions greater than 1.5 mm. Fraunhofer IWS has developed a new laser processing head to increase the precision of laser wire cladding and make it applicable for the smallest structure sizes. COAXwire mini enables the use of the finest wires to produce metallic layers and structures with a resolu-tion that was previously impossible to achieve.

COAXwire mini

The newly developed and patented COAXwire mini laser optics is now available for processing wires with a diameter of 0.1 to 1.0 mm. It is based on the proven coaxial three-beam principle, which enables precise and omni-directional processing in all standard welding positions. The design of the welding head, wire feeder and adjustment device for processing ultrafine wires from 0.1 mm in diameter was a focal point of development. A dedicated high-precision wire drive unit was developed for this purpose. This qualifies the automated laser wire cladding for generating very small structures with a weld seam from 0.2 mm.

Another new feature is the use of solid-state lasers in the visible wavelength range from 450 to 550 nm, in addition to the commonly used infrared radiation with wavelengths between 890 and 1100 nm.

Operation Principle

Depending on the absorption behavior of the metal alloys used as weld metal or substrate, the new optics can be operated with different laser wavelengths. This means that a wide range of metallic materials can be processed, which are used, for example, in the aerospace, medical technology and toolmaking industries.

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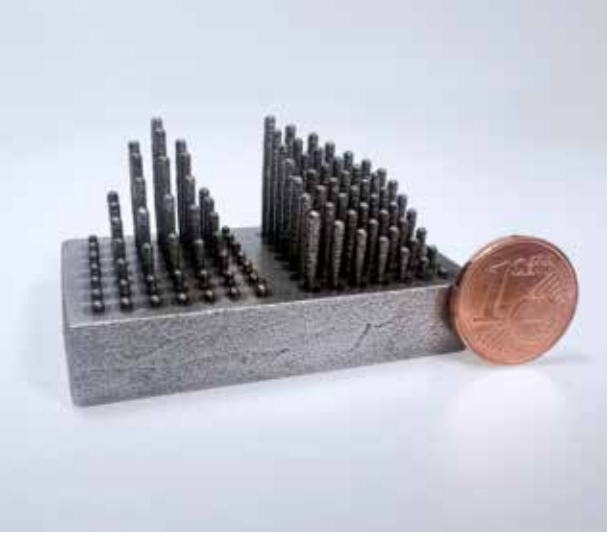


With a fixed imaging ratio of 1:2, the focus diameter is adjusted to the filler wire by selecting the fiber diameter. An integrated inline camera monitors the processes, cross-flow nozzles deflect interfering spatter and the central wire feed can be finely adjusted in the XYZ direction. Besides its low weight and compact design, the water-cooled, combined external shielding gas supply and fume extraction module is another highlight of the COAXwire mini. The integrated shielding gas supply generates an oxygen-free shielding gas atmosphere at the process zone, which enables oxidation-free laser cladding even on critical materials such as titanium. The integrated extraction system removes metal vapors resulting from the welding process, thus increasing work safety.

Application Examples

COAXwire mini is suitable for wire laser cladding with wire diameters of less than 0.6 mm in the following areas:

- Surface treatment of filigree components in toolmaking
- Additive manufacturing of ultra-fine structures in the electronics industry, medicine and dental technology
- 3D build-up and repair of structures on existing components in engine and turbine construction

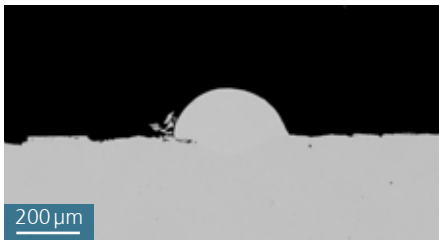
Advantages

- Compatible with fiber, disk, diode, blue and green lasers (450-55 nm and 890-1100 nm)
- Small, lightweight, coaxial, modular, robust and ecological

Left:
Generated pin structures in different heights, e. g. for connecting elements or cooling structures

Middle:
3D-generated hollow cones (closed on the left, open on the right) with a wire diameter of 0.4 mm and a wall thickness of 1 mm

Right:
Steel tube with welded copper structures, e. g. for wear protection or electrical engineering applications



Cross-section of a single track with 0.1 mm wire diameter and 100 W laser power

Technical Data

Height x width x depth	480 x 135 x 160 mm
Weight	10 kg
Laser spot size	0.3 - 3 mm
Wave length	450–550 nm and 890–1100 nm
Laser power	up to 3 kW
Beam quality	SPP ≤ 30 mm*mrad NA ≤ 0,12
Fiber connector	LLK-D, QBH (others on request)
Wire diameter	0.4–1.0 mm (on request 0.1–0.3 mm)
Wire material	Ti, Fe, Ni, Al, Cu, Au
Integrated functions	Integrated local shielding gas supply or crossjet, protective glass, cooling water flow and temperature monitoring, inline process monitoring