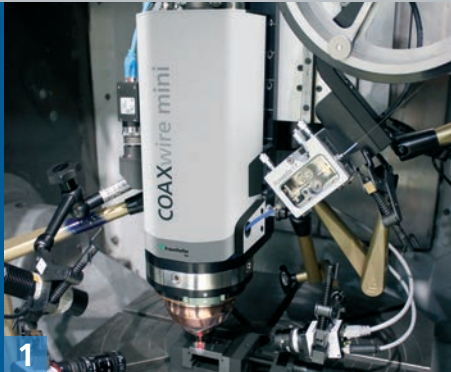
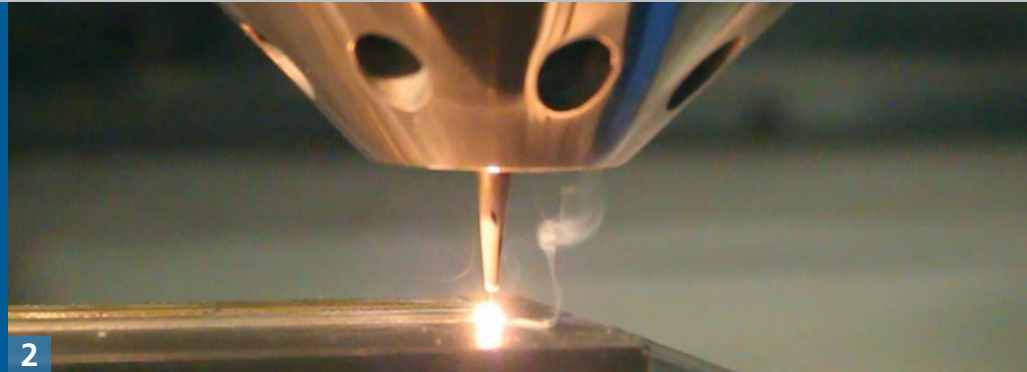




FRAUNHOFER INSTITUTE FOR MATERIAL AND BEAM TECHNOLOGY IWS



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- 1 *Integration of the COAXwire mini in a 5-axis CNC system.*
- 2 *Laser deposition process showing the integrated smoke and fume extraction module.*

COAXwire mini

LASER CLADDING WITH EXTRA FINE WIRES

Fraunhofer IWS has developed the innovative laser processing head COAXwiremini for the processing of finest metal wires in surface cladding and AM. This head allows the production of metallic coatings and three-dimensional structures in small dimensions previously unattainable. It is the answer on the industrial request for efficient and resource-saving production methods. Surely, wire is a proven feedstock material in additive welding processes, but so far existing solutions allow only standard wires with a diameter of 0.8 to 1.2 mm.

COAXwire mini

The newly developed and patented COAXwiremini laser deposition head is now available for processing wires of 0.1 to 0.6 mm in diameter. It is based on the proven coaxial three-beam principle. It enables processing in all welding positions in a precise and omi-directional laser deposition procedure. Besides the system technology, current developments have also been focused on the qualification of the

laser process specially for ultrafine wires below 0.4 mm. The result is a long-term stable process with wires down to 0.1 mm, such as those for wires with larger dimensions. In contrast to powder deposition in small dimensions, the material utilization is always 100 %, independently from wire diameter, welding position, and track geometry. An additional new feature is the increased range of suitable laser wavelengths. Lasers with 450 to 550 nm (green, blue) can be used like the common infrared lasers with 890 and 1100 nm. Thus, a broad spectrum of metallic materials can be processed efficiently. The integrated new wire drive unit guarantees a stable supply even of these extra fine wires.

Controls

With a fixed optical aspect ratio of 1:2, the focus diameter can easily be set by the choice of the fiber diameter according to the wire dimensions. An integrated in-line camera observes the process, cross-jet nozzles deflect disturbing spatters, and

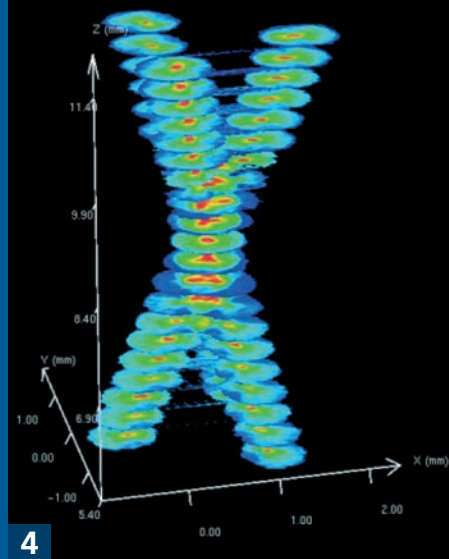
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- 3, 5** Additive manufacturing of metal samples out of steel and Nickel base super alloys using 0.4 mm wire
- 4** Beam diagnostics: caustic of the triple beam.

the central wire feed can be finely adjusted in the XYZ direction. Apart from its low weight and compact design, the water-cooled smoke and fume extraction module is another highlight of the COAXwire mini. The metal vapor resulting from cladding is extracted in any direction for clean working conditions (see fig. 2).

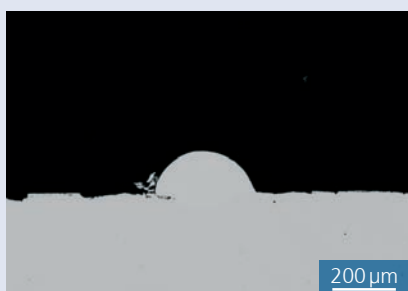
Application

The application spectrum of the COAXwire mini covers wire deposition of wire diameters < 0.6 mm in the following fields:

- Surface cladding of filigree components, e. g. in tool making
- Additive manufacturing of finest structures in the electronics industry as well as in medicine and dental technology
- 3D build-up or repair of structures on existing components in engine and turbine construction



Cross-sections of wall structures produced with 0.4 mm wire diameter.



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

Technical data

| | |
|--------------------------------|---|
| Height x width x depth | 480 mm x 135 mm x 160 mm |
| Weight | ~10 kg |
| Wavelengths | 450–550 nm and 890–1100 nm |
| Laser power | Up to 1 kW |
| Requested beam quality | SPP ≤ 30 mm* mrad |
| Numerical apertur of the fiber | NA ≤ 0.12 |
| Fiber connector | LLK-D, QBH (others on request) |
| Wire diameter | 0.1–0.6 mm |
| Wire material | Ti, Fe, Ni, Al, Cu, Au |
| Functions and options | <ul style="list-style-type: none"> ■ Smoke and fume extraction ■ Protective glasses, monitored and easy to exchange ■ Permanent monitoring of media flows (cooling water, gases) ■ Temperature monitoring of the head ■ In-line camera for process monitoring ■ Camera system and software for closed-loop process control ■ Specially developed wire feeder |