Fraunhofer IWS Dresden

FRAUNHOFER-INSTITUT FÜR WERKSTOFF- UND STRAHLTECHNIK IWS

POWDER FEED NOZZLES AND WIRE FEED

Omni-directional, accurate and industrially tested material supply for laser beam deposition welding

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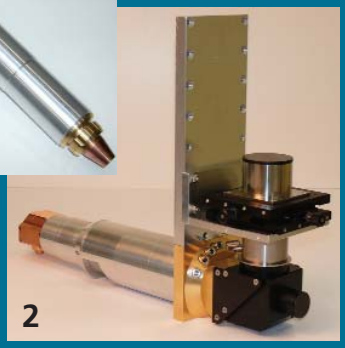
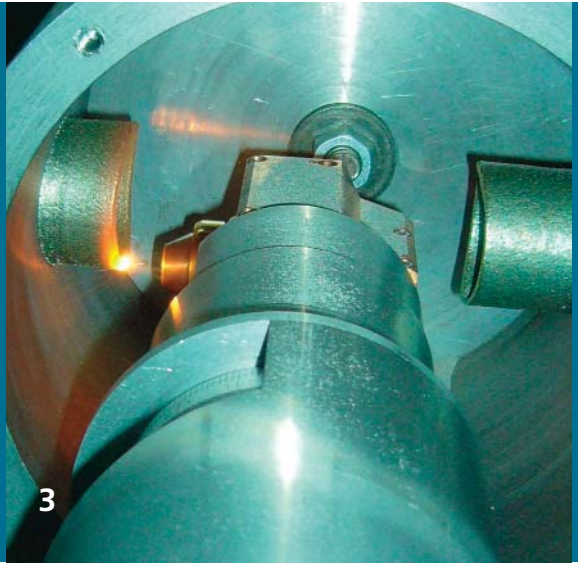
Motivation

The accurate manufacture of protective and functional layers, as well as the rapid repair of components, are some of the most frequent areas of application for laser beam deposition welding. Systems optimized with regard to material feed are an important precondition for successful use of the procedure in industry. They have to be easy to handle while allowing an exact and stable feed of the weld filler material, as well as to less well accessible processing areas. Guaranteeing an omni-directional material feed is indispensable for numerous applications.

Solution

With the modular powder feed nozzle system COAXn from the Fraunhofer IWS Dresden and with the new FLEXILAS principle for omni-directional wire feed, flexible tools are now available to users. Together with the appropriate laser technology, these can easily be integrated into tool machines and robot-based processing systems. The modular powder feed nozzles from the modular design system COAXn basically consist of commercially available laser optics, an xyz-adapter to connect the nozzle, as well as the actual coaxial powder feed nozzle with connections for all process gases and cooling water. The optimum nozzle configuration can be prepared according to the requirements of each application.





Results and application examples

FLEXILAS

- novel manufacturing principle of laser processing using central wire and powder feed
- special beam splitter optics first of all divide up the laser beam, with subsequent focusing on a circular arc spot
- the position of the partial beams permits the arrangement of a wire nozzle with integrated equipment connection in the centre
- additional material is fed into the area exactly midway between the symmetrical laser beams and the molten pool on the surface of the component
- powder and solid or cored wire as a welding and soldering additive available for the first time with omnidirectional capacity
- welding wires with diameters of 1.0 and 1.2 mm can currently be processed
- a welding speed of 1.7 m min^{-1} using a 1 kW Nd:YAG laser power and a spot diameter of 1.4 mm

Wide angled nozzle COAX11$_{square}$

- coaxial powder feed to rectangular arc spots
- using high performance diode lasers of up to 10 kW laser performance and rectangular arc spot section, individual tracks of metal alloys with a width of 8 to 22 mm can be manufactured
- powder efficiency factors of up to 90 %
- deposition rate and bead geometry with plasma-powder deposition welding (PTA) comparable
- deposition rate ≤ 9 kg h^{-1}

COAX13

- deposition welding with lasers of highest beam quality on those parts of the component which are difficult to access
- powder feed by means of 4 powder streams
- large immersion depth, circa 200 mm
- extreme welding positions possible, ± 90 ° tilt

COAX11$_{square}$ with rectangular powder section for the deposition welding of metal alloys with high productivity

Interior coating head COAX203$_{icu}$

- precise contour welding on difficult-to-reach welding positions can be carried out
- internal equipment connection, including local protective gas feed
- a fully water cooled, uninterrupted processing time possible over hours
- powder supply feed rates of 0.6 up to 1.2 kg h^{-1}

FLEXILAS head for central wire feed

Parameters of the powder feed nozzles

powder focus: 1 - 3 mm Ø or rectangular geometry, e.g. 3 x 18 mm^2	
deposition rates: according to precision 0.1 up to 9 kg h^{-1} metal powder	
powder utilization:	≤ 95 %
minimum focal length of the laser optics:	70 mm
minimum track width:	150 µm
maximum track widths with 8 kW diode laser:	22 mm

Parameters of the wire feed

directed wire feed for stable immersion into the molten pool	
integrated wire nozzles with water cooling and protective gas feed	
wire diameter:	1.0 und 1.2 mm
wire feeding speeds:	1 - 2 m min^{-1}
typical track widths:	1.4 mm

1 Coaxial processing head COAX13
2 Modular interior coating system COAX203$_{icu}$ for contour deposition welding on low interior areas
3 Process of the 3D deposition welding on inner areas