School for Additive Manufacturing

LASER ZENTRUM HANNOVER e.V.

Development of a laser double-wire Directed Energy Deposition process for Functionally Graded Materials and in-situ alloying

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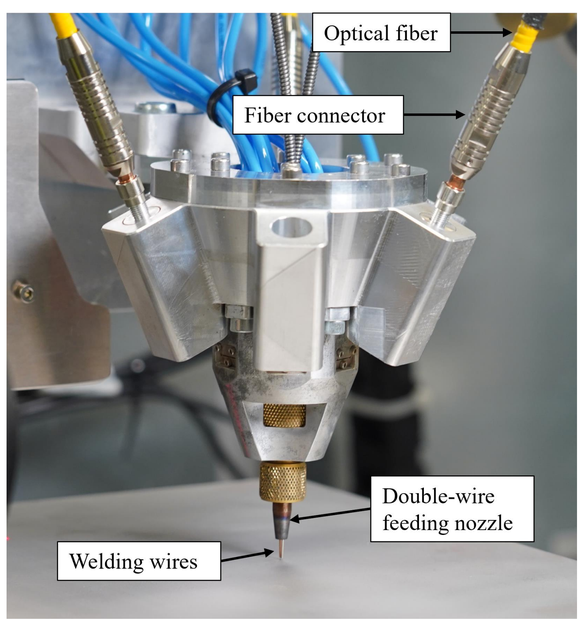
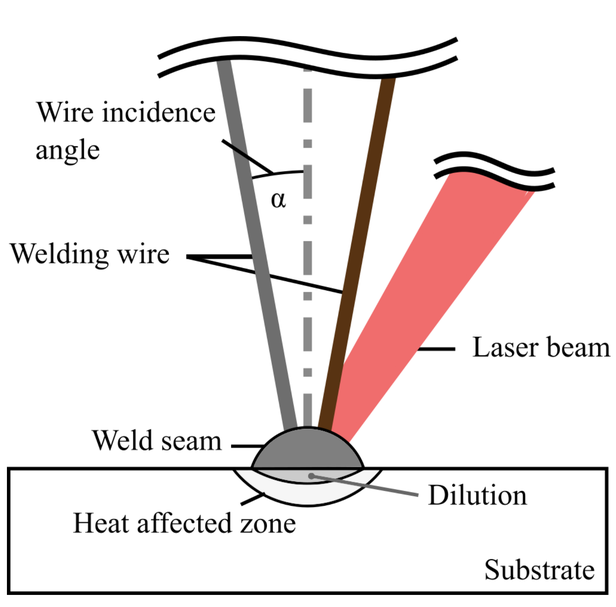
Project Goals

- Development of a Laser Double-wire Directed Energy Deposition process (LD-DED)
- Utilizing high material efficiency of the laser wire process for multi-material additive manufacturing
- Enabling omnidirectional wire based build up of in-situ fabricated alloys and Functionally Graded Materials

Laser double-wire Directed Energy Deposition





Left: Multiple Diode Coaxial Laser processing head

- 660 W combined output power from three individually controllable fiber guided laser diodes
- Wire diameter of 0.8 mm applicable

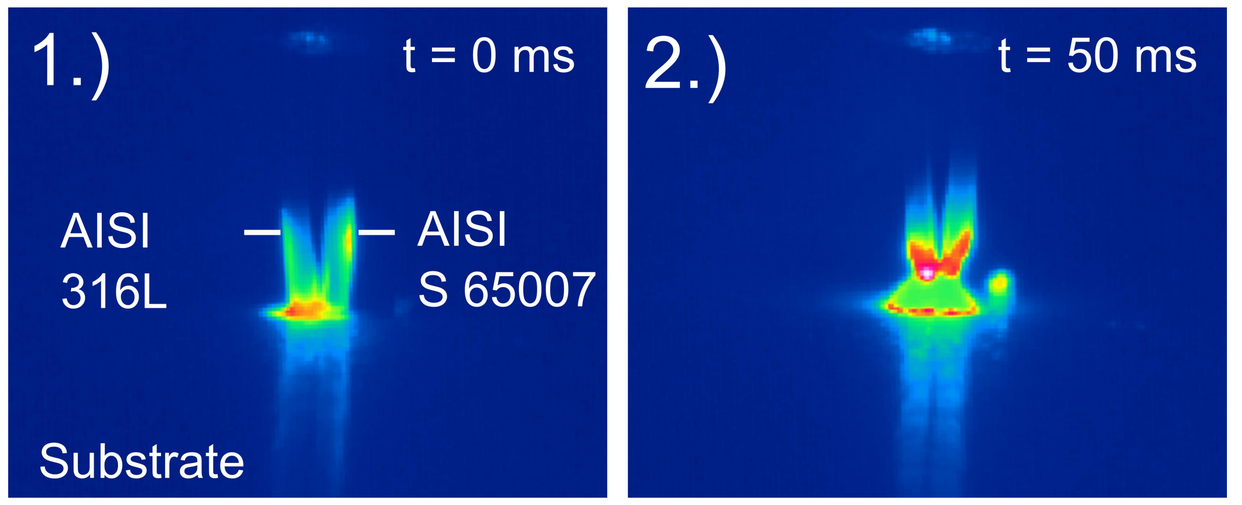
Right: Schematic drawing of the Laser Double-wire Directed Energy Deposition (LD-DED) process

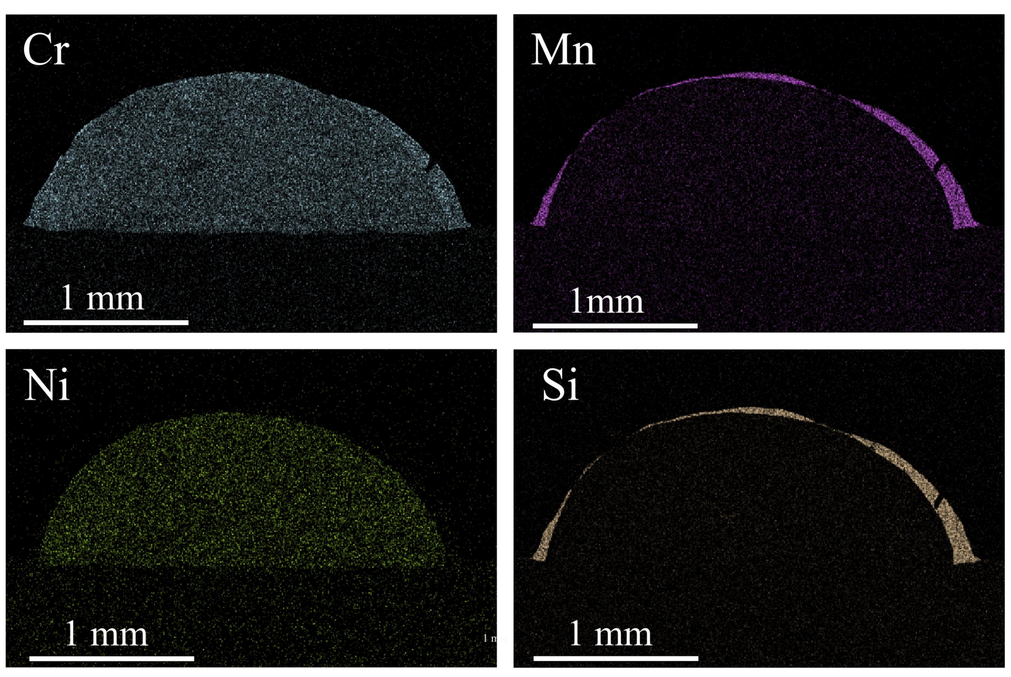
- Double-wire process enables in-situ alloying
- Small wire angles of incidence focus on omnidirectional additive manufacturing

Results

Right: Thermographic images of the LD-DED process

- Early formation of a common melt flow into the melt pool increases intermixing duration
- Material composition controllable by adjusting the wire feeding velocities





Left: Scanning Electron Microscopy images with element distribution in weld seam cross-section of 40% AISI 316L and 60% ER 70S-6

- Homogenous element distribution present for all investigated element contents
- Local enrichment of Si and Mn present at the weld seam surface
- Further: Homogenous mixing present for cross-sections as well as flat ground samples

Conclusion and outlook

- LD-DED process representing a material efficient manufacturing process capable of producing alloys and Functionally Graded Materials in-situ with homogenous intermixing
- Individually controllable laser output power and wire feeding velocities enable new opportunities to the process controllability → various materials with differing melting temperatures processable

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