Technical University of Munich
TUM School of Engineering and Design
Professorship of Laser-based Additive Manufacturing

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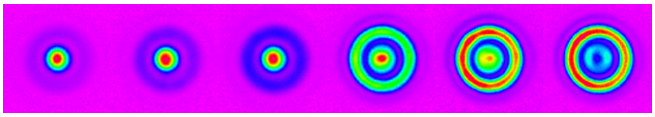
Additive Manufacturing of Inconel 738 Super-Alloy (BA/SA/MA)

Initial situation

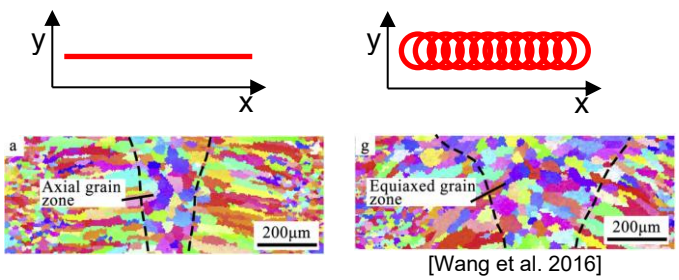
At the Professorship of Laser-based Additive Manufacturing, the research team focuses on advancing laser- and powder bed-based additive manufacturing processes. Powder bed fusion using a laser beam (PBF-LB/M) enables the production of highly complex, functionally optimized metallic components with unprecedented design freedom.
Nickel-based superalloys such as Inconel 738 are of particular interest for high-temperature aerospace and energy applications due to their excellent creep resistance and mechanical strength. However, their processing via PBF-LB/M remains challenging because of their susceptibility to cracking and the complex solidification behavior during laser melting.

Aim and content of the work

The aim of the thesis is to identify and evaluate a suitable process window for PBF-LB/M processing of Inconel 738 using advanced beam shaping and laser oscillation strategies. Building on existing internal experiments, the microstructure shall be tailored to improve mechanical properties by adjusting the laser-material interaction and thermal history.



Different Laser Beam shapes with ring/core power distribution



[Wang et al. 2016]

Continuous wave (left) and circular oscillation (right) laser scan trajectory and corresponding microstructure

Example of an IN718-nozzle

The following work packages (WP) form the content of the thesis:

WP1: Literature review on PBF-LB/M of nickel-based superalloys, laser beam shaping, and oscillation strategies
WP2: Analysis of existing internal experiments and definition of process parameter windows
WP3: Experimental manufacturing of samples using selected process windows
WP4: Microstructural characterization (e.g., metallography, porosity analysis)
WP5: Evaluation of microstructure-property relationships and derivation of optimization measures
WP6: Documentation and presentation of results

Requirements / Application documents

- Initiative and creativity
- Interest in the subject area of additive manufacturing
- Reliability

Please send your application with a short motivation letter and a current transcript of grades to:

Contact

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