

Additive manufacturing of Inconel 718 for airplane applications
towards process-microstructure-property relationships
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Additive manufacturing (AM) has opened up a world of new opportunities towards mold-free production of complex products. Products can be made with increased functionality, with a topologically optimized shape and/or designed to individual needs. One of the more important approaches for metal products is laser powder bed fusion (L-PBF), where metal powder is deposited layer by layer and a dedicated laser is used to melt the powder at selected locations according to the product design.

Recently, Aeronamic B.V. (Almelo) started a co-operation with the Fraunhofer Project Center and the University of Twente to apply the L-PBF process for the production of airplane parts. The objective of the co-operation is to further develop the process and for Aeronamic to become a certified supplier of L-PBF parts on the basis of Inconel 718, a high-strength corrosion-resistant nickel chromium alloy.

Exploratory experiments have shown that L-PBF with Inconel 718 is possible. These experiments solely concentrated on the defect less manufacturing of the parts and not on control of the microstructure.

In this master assignment the relation between process conditions, microstructure and (mechanical) properties will be investigated. The research comprises both experimental work (hardness, tensile testing) and theoretical modelling.

The objective of the master project is to investigate the relation between process conditions and the microstructure. The following aspects should be included:

- (i) Literature study on the role of process conditions on microstructure development of Inconel 718.
- (ii) Experimental program dedicated to the relation between process conditions and microstructure. Various techniques may be used for the determination of the mechanical properties (hardness, tensile testing). Microstructural analysis may incorporate Light Microscopy, Scanning Electron Microscopy although more techniques are available.
- (iii) Establish (model based) relations between relevant microstructural features and the process conditions to support microstructural optimization.

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