Master Thesis Project

Understanding low pressure atmospheric contaminants in Electron Beam Powder Bed Fusion (EB-PBF) additive manufacturing

Background

Additive manufacturing has in recent years emerged as a viable candidate for manufacturing of complex components with highly reduced weight and assembly complexity. While regularly manufactured parts involve many different types of process steps and a final component assembly, additive manufacturing offers part complexity „for free“.

Some of the challenges faced when delving into additive manufacturing include consideration of the process atmosphere. While quite well-studied in laser based processes, which occur at near atmospheric pressures, the effect of the process atmosphere in electron beam powder bed fusion (EB-PBF) is less known. This is often attributed to the necessity of near-vacuum conditions in an EB-PBF process. However, several studies indicate that powder degrades and oxidizes after each process cycle.

Description of the thesis work

Due to its high surface area, metal powder possesses high reactivity and hence is prone to the oxidation as well as moisture absorption, depending on the alloy composition and powder handling, AM processing as well as re-use during AM processing. This can result in the oxide inclusion as well as porosity formation that can have detrimental effect on the mechanical properties of the components, especially fatigue. Hence, the scope of this thesis is to devise a method and quantitatively establish the relationship between process atmosphere inside an Arcam EB-PBF print chamber and the degradation of the powder.

Organization

Thesis will be performed at the Department of Industrial and Materials Science at Chalmers, that is hosting the competence centre “*Centre for additive manufacturing – metal (CAM^2)*”, in collaboration with Linde and Arcam (GE Additive). The student will have access to expertise in additive manufacturing, atmospheric considerations, gas analysis etc., from GE Additive and Linde Gas. Established instruments for quantitatively monitoring the atmosphere as well as access to the Arcam EB-PBF machines will be provided. The student will be free to explore suitable approaches under the guidance of industrial supervisors from GE Additive and Linde Gas and academic supervisor from Chalmers.

Qualifications: Interest and curiosity in the subject, good knowledge of material science and additive manufacturing as well as good analytical skills.

Extent and time plan 30 hp master thesis project, starting in January 2021 till June 2021.

Financial coverage: 39 000 SEK after submission of approved Thesis

Supervisors and examiners:

Industrial supervisor: Dr Joakim Ålgårdh, GE Additive: Joakim.Algardh@ge.com

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