Master Thesis Project

Understanding powder properties variations when reusing materials in Powder Bed Fusion (PBF) additive manufacturing.

Background

Additive manufacturing (AM) processes have disrupted the way to design and manufacture not only consumer goods but also industrial products. The design freedom of AM allows to build complex shapes that can be topologically optimized to reduce weight. While sustractive methods remove material, the additive nature of AM processes allows to reduce waste by only adding material where it is needed.

Some of the challengues of Powder Bed Fusion (PBF) is to safely reuse the powder that has not been melted and therefore formed a solid part. When reusing the powders, properties such as chemical composition and morphology can suffer variations that impact the powder spreadability and flowability. Exisiting literature indicates that powder degrades and oxidizes while due to process high temperature, moisture acumulated in the powder will dry. This leads to a slight improvement in flowability, however process repeatibility is key to ensure part quality.

Description of the thesis work

Due to the high energy applied to the powder, spatter generation and powder agglomerations can take place during the build process. The remaining powder will be collected at the end of the process and sieved. Nonetheless, the sieving mesh size and handling can impact on powder size segregation and slight changes in particle size distribution (PSD) may occur. The effect of reusing powder as well as variations on powder properties can be measured by rheology tests.

The scope of this thesis is to link the powder variations during reuse and different powder qualities with rheological properties. The modern powder characterization tools, namely Revolution Powder Analyzer (RPA) and Laser Diffraction Particle Size Analyzer, will be used as a quantifiable testing methods. Ultimately, the spreading behavior in different machine models will be compared to the results of the rotating drum. Additionally, moisture effect will be studied by in-situ drying the powder and performing multi-flow test. A variety of virgin and reused and powders will be studied.

Organization

Thesis will be performed at the Department of Industrial and Materials Science at Chalmers in the frame of the Centre for Additive Manufacturing – Metal (CAM^2: https://www.chalmers.se/en/centres/cam2/Pages/default.aspx). The student will have access to expertise in additive manufacturing, powder characterization and properties analysis from RISE. The student will be free to explore suitable approaches and propose a research plan to conduct the experimental work and could make use of simulation tools to study the powder spreading behavior.

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 is ASAP but no later than January 2022.

Supervisors and examiners:

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