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Master Thesis Project

Recyclable and sustainable metal additive manufacturing materials

Background

Metal additive manufacturing (AM) technologies are considered sustainable mainly due to the design freedom and additive nature. 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. However, there are challengues to solve to further increase the process sustainability.

One of the most industrialized metal AM processes: Powder Bed Fusion (PBF) requires a large amount of support structures to anchor the part on the build plate. This enables the part gaining stability to avoid any deformation due to thermal distortions from rapid cooling of the molten material. These structures together with failed components and discarded metal powder become process waste, as shown in Fig. 1. Hence, when upscaling the PBF process this waste increases becoming a challenge to overcome.

Fig. 1 AM process waste

Description of the thesis work

This project will be carried out in collaboration with f3nice, producer of AM feedstock with a patent pending process that allows the use of up to 100% metal scrap as input material. The work will be focused on testing the materials and mechanical properties of parts built with recycled powder from process waste, in comparison with commercial virgin powder. The student will be free to explore suitable approaches and propose a research plan to conduct the experimental work by using optical microscopy, density tests, Scanning Electron Microscopy (SEM), hardness and static testing (tensile bars). Preliminary analysis of the (virgin and recycled) powder flowability will be carried out by using powder characterization equipment, namely Revolution Powder Analyzer (RPA).

The scope of this thesis is to link the material properties to powder quality. The outcome of this thesis will serve as a starting point to shift production of metal powder for PBF and the rest of metal AM technologies to greener and sustainable materials.

Organization

The thesis work will be performed at the Department of Industrial and Materials Science at in the frame of the CAM² centre: 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 Chalmers and the expertise from f3nice on powder atomization, scrap management and treatment. Basic knowledge of life-cycle assessment will be developed based on the student interest.

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

Time plan: 30 hp master thesis project, starting as soon as possible no later than January 2022.

Supervisors and examiners:

Supervisor at f3nice: Dr Matteo Vanazzi, f3nice: matteo.vanazzi@f3nice.com
Supervisor at Chalmers: Dr Laura Cordova, IMS Chalmers: laura.cordova@chalmers.se
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