Evaluation of Powder Characteristics for Selective Laser Melting by means of Powder Rheology

Background
Selective laser melting (SLM) is a powder bed fusion additive manufacturing process in which the thermal energy of a laser beam melts and fuses areas of the powder bed. The characteristics of the metal powder used in the SLM process influence the robustness and efficiency of this fabrication method. To be able to manufacture components with densities close to theoretical values, sufficient mechanical properties and high surface quality, the SLM process requires dense and uniformly packed layers of powder prior to laser exposure. To establish relevant methods to characterize powder properties for SLM is of urgent interest for metal powder producers as well as industrial SLM machine operators.

Objective and Research Questions
The objective is to gain knowledge of the rheological properties of different powder samples. For this purpose, a standardized powder rheometer (FT4, Freeman Technology) will be used to measure the flow properties of different samples. The effect of different procedures for powder storage, handling and sampling on the rheological behaviour of different samples is to be investigated. Influence of the surface chemistry of the powder (e.g. surface oxides or humidity) on its flow response is to be evaluated.

Work Description
Rheological measurements will be performed at Swerea IVF in Mölndal. Surface chemistry evaluations will be carried-out at Chalmers University of Technology, Gothenburg. The major part of the experimental work will include rheological measurements of different metal powders using different rheological test methods. The thesis work is part of the Department of Industrial and Materials Science at Chalmers University. However, the applicant will be able to perform the necessary evaluations at Swerea IVF. The thesis will include:

- Literature study
- Powder Rheology
- Surface Chemistry (Scanning Electron Microscopy, X-ray Photoelectron Spectroscopy)
- Evaluation of the results

Qualification
We are looking for you who are studying towards a Master of Science degree in the field of material science, applied physics or mechanical engineering. The thesis work is suitable for someone who is interested in materials processing. Good writing skills in English is important.

Start of the thesis work:
Time frame: The thesis covers 30 credits / 20 weeks
Contact:
- Docent Yu Cao (yu.cao@chalmers.se); Academic supervisor and examiner
- Sepehr Hatami (Sepehr.hatami@swerea.se); Industrial supervisor
- Ola Lyckfeldt (ola.lyckfeldt@swerea.se); Industrial supervisor