Master Thesis Project

Method for screening of suitability of alloys for PBF-LB process

Background
Integrated Computerized Materials Engineering (ICME) is a method to develop alloys that fulfill certain criteria starting only with calculation/simulation of micro structure and properties. However, the development goals are complex and simulations are rarely accurate enough to provide sufficient quality in the output. Experimental verification of a new alloy is very expensive and it is difficult to screen large numbers of alloys using the intended production process (PBF-LB+Heat treatment). In order to improve quality of the simulations and of the end result, an intermediate experimental check point can be created. Using this approach specific functions or criteria can be checked much earlier in the verification chain and thus higher efficiency of the whole development activity is achieved.

Description of the thesis work
A literature review will be performed that cover ICME, Arc melting, PBF-LB process and Ni-base superalloys. The experimental work is limited to Ni-Base superalloys and will be a mix of existing alloys and model alloys. Small “buttons” of the material will be created in the Arc melter and the quality of the button will be safeguarded by microstructure analysis and chemical analysis. The microstructure is compared with the expected (by Thermo-calc and literature) microstructure. Selected buttons will be irradiated with laser at different line energies and again the resulting microstructure will be characterized and compared to the expected result. The presence of defects, e.g. cracks is an important part of the characterization. Finally characterization of the arc melted buttons will be compared to material printed in an PBF-LB printer and the suitability of the method for screening of alloy candidates can be assessed.

Organization
Thesis will be performed at the Department of Industrial and Materials Science at Chalmers, in the frame of the competence centre “Centre for additive manufacturing – metal (CAM²)”. The student will have access to relevant equipment, such as vacuum arc melter, metallography and microscopy. The student will be free to explore suitable approaches under the guidance of industrial supervisors from Höganäs AB and academic supervisor from Chalmers.

Extent and time plan
30 hp master thesis project, starting in January 2024 till June 2024

Qualifications: Interest and curiosity in the subject, good knowledge of material science and additive manufacturing as well as good analytical skills. Knowledge in Ni-base superalloys is an advantage.

Supervisors and examiners:
Industrial supervisor: Sven Bengtsson, Höganäs AB, sven.bengtsson@hoganas.com
Supervisor at Chalmers: Dmitri Riabov, IMS Chalmers, riabov@chalmers.se
Examiner at Chalmers: Eduard Hryha, IMS Chalmers, hryha@chalmers.se