Department of Industrial and Materials Science
Chalmers University of Technology 10/2020

Ex-situ inoculation studies of high entropy alloys produced by laser powder bed fusion

MSc thesis proposal (30/60 credits)

Background:

High entropy alloys (HEAs) are a novel class of alloys which have attracted wide spread interests of the research community over the last decade. This novel class of alloys contain multiple principal elements in nearly equiatomic proportions, which increases the configurational entropy and hence reduces the Gibbs free energy required to form stable solid solutions. The unprecedented compositional complexity has reportedly enabled HEAs to perform better than conventional alloys in various situations.

Manufacturing HEAs using additive manufacturing techhniques such as laser powder bed fusion (L-PBF) results in reducing the phase segregation and preventing the formation of detrimental phases, owing to the very high solidification rates. However, the rapid solidification during the layer by layer printing induces high thermal gradients, resulting in the epiaxial growth of columnar grains in the build direction. This also introduces the undesired anisotropy in microstructure with respect to various build orientations.

Aim:

The main aim of this study is to achieve the microstructural control of the CoCrNi alloys produced by L-PBF. One approach is by mixing the nanosized particles which would act as inoculants during the rapid melting and solidification of the L-PBF process. A systematic study on the mixing characteristics of inoculant particles with the metallic powder and its influence on the microstructure and resulting properties of the printed parts will be studied as the main part of this work.

Tasks:

- Literature research on additive manufacturing, HEAs and solidification studies
- Qualitative studies on the influence of mixing parameters on the resultant microstructure of metallic powders
- Design of experiments to optimize the printing parameters and study the influence of mixing characteristics and printing parameters on the resulting microstructure and properties of printed materials.
- Reporting

Student background:

- Good knowledge in materials science, mainly phase trasformations, solidification and microstructure of metallic materials.
- Understanding of the additive manufacturing process, mainly the L-PBF process.
- Good analytical skills.

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