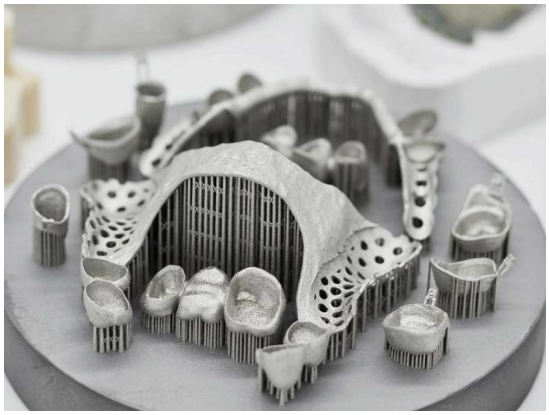
Master/Semester Thesis: Computer vision-based analysis of strain-induced phase transformations in additively manufactured Co-Cr-W alloy

Motivation: Post the advent of additive manufacturing, one of the major research interests of the industry is not only to optimize the additive manufacturing process but to exploit its capabilities to create microstructurally tailored parts. By varying process parameters, such as scanning speed, laser power, beam profile, scan pattern, etc., it is possible to locally manipulate the microstructure to create application-specific crystallographic textures that were previously unachievable. However, this unravels a significant challenge of understanding the mechanical behavior of such microstructures at the fundamental level. The need of the hour is to develop such an understanding by combining state-of-the-art techniques, such as X-ray diffraction (XRD), Electron backscatter diffraction (EBSD), and in-situ optical microscopy, with advanced data analysis techniques employing computer vision.

The goal: Co-Cr alloys are widely used in medical implants and high-temperature turbines. Very often, parts of these alloys are made additively.



These alloys, classified as low-stacking-fault-energy materials, exhibit a phase transformation from FCC to HCP upon straining. This, combined with the textured microstructure resulting from additive manufacturing, leads to surprisingly distinct and directionally dependent elastic-plastic and fracture properties. The goal of the thesis is to develop a quantitative understanding of the phase transformation using characterization tools such as XRD, EBSD, and in situ optical microscopy. To do so, samples would be deformed under an optical microscope. The generated videos would be analyzed using computer vision code. To quantify the new phase formed, these samples shall be analyzed by XRD and EBSD before and after deformation.

Work packages:

- Preliminary literature survey to develop an understanding of the phase transformation
- Preparation of the samples
- Performing the experiments in the suggested workflow
- Analysis of the data from all experiments
- Writing the thesis

Who shall apply?

- Students from a Materials Science, Mechanical Engineering, or Computer Science background with a willingness to learn techniques across domains.
- Very good English or German language skills
- Experience in programming with MATLAB or Python

If you are interested, please send an application with your CV and transcript of records to nishant.mistry@tum.de

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