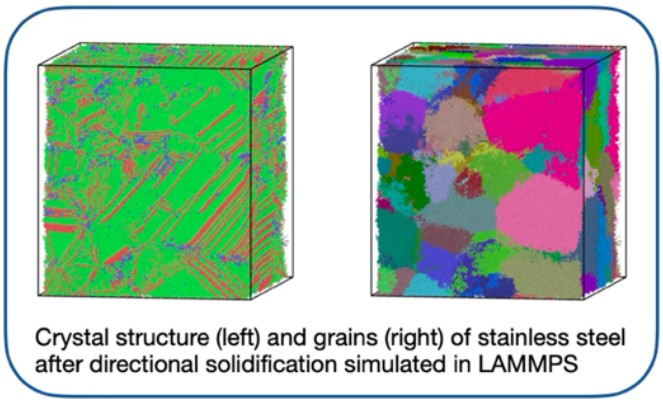
Professorship of Multiscale Modeling of Fluid Materials
TUM School of Engineering and Design
Technical University of Munich

Simulating effects of alloy composition on solidification

Motivation

Additive Manufacturing (AM) allows the production of parts with complex geometries that are unattainable with conventional manufacturing processes. Laser powder bed fusion (LPBF) is particularly relevant for constructing strong, lightweight metal parts. However, standard metals for lightweight applications, such as aluminum (Al), are only printable in a certain processing window and thus not well suited for these applications. Next to process design, material design is a key factor in overcoming this issue. Microalloying Al with other metals, such as titanium (Ti) and zirconium (Zr), can influence the microstructures developing during the solidification, making the alloy usable for LPBF.

In a previous project, we could find key characteristics of Ti-microalloying and pointed out the main obstacles to overcome. With this knowledge, we want to verify and extend our findings.



Crystal structure (left) and grains (right) of stainless steel after directional solidification simulated in LAMMPS

Goal

This Thesis aims to analyze the influence of adding different metals to aluminum in varying quantities on the nucleation process, the resulting crystal structures, and material propterties after solidification.

Tasks

- Familiarize yourself with molecular dynamics simulation
- Familiarize yourself with the solidification of metals
- Simulate the solidification of different aluminum alloys in LAMMPS
- Simulate solidification of different alloys in LAMMPS
- Analyze the nucleation behaviour
- Evaluate the mechanical properties of solidified alloys

Requirements

- Interest in additive manufacturing of metals
- Experience with molecular dynamics and LAMMPS is advantageous
- Highly motivated

Application

If you are interested in this project or have further questions, please write an email to ian.stoermer@tum.de including:

- A brief introduction of yourself (motivation, background, CV)
- Transcript of Records from your Bachelor and Master program.