

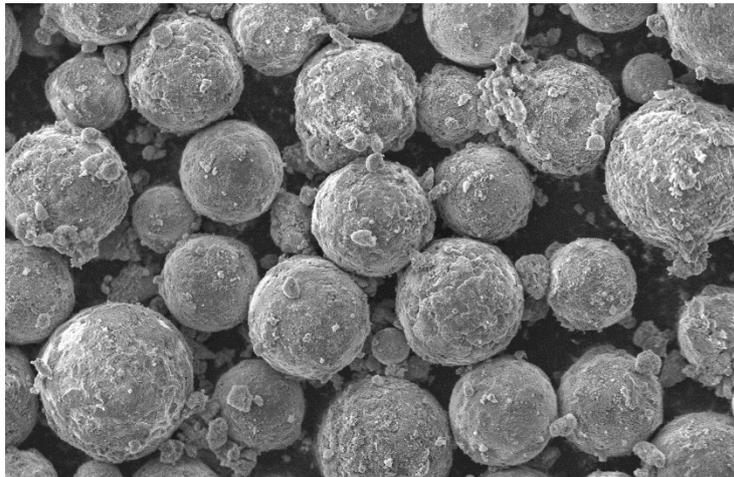
Master thesis

Al-Ti alloys for LPBF: study on the effect of trialuminides**Summary**

Currently available aluminum alloys for additive manufacturing are not able to meet all the requirements for high strength, low cost, good workability, and sustainable raw material sources, because they are either adapted from the casting sector (e.g., AlSi10Mg), and/or too expensive due to the use of non-sustainable elements (e.g. Scandium in Scalmalloy). In an ongoing PhD project, a new aluminum alloy shall be developed, meeting typical mechanical and physical requirement profiles of relevant industries and being reliably processable by Laser Powder Bed Fusion (LPBF)

To reach this goal, the new alloy should contain a combination of alloying elements able to create a fine microstructure with coherent strengthening precipitates stable upon a wide range of temperatures. In preliminary studies, Titanium showed a high potential in creating metastable cubic phases that are able to promote grain refinement and avoid hot cracking.

The goal of the thesis is to study the effect of the addition of different wt.% of Ti to Al powder, finding the optimal printing parameters and analyze the microstructure of the built samples. Effect on mechanical properties will be analyzed via tensile tests and selected heat treatments will be needed to determine the stability of the precipitates and the mechanical properties at high temperature.

**Work packages**

- WP 1: Literature research
- WP 2: Selection of Al-Ti mixture and printing of the samples. Parameters optimization
- WP 3: Microstructure analyses on the as built samples
- WP 4: Tensile tests analyses on as built samples and heat treatments
- WP 5: Writing of the report

Needed skills / interests

Materials science/mechanical engineering students are welcome to apply. Hands on skills, creativity, basic knowledge of metallurgy are welcome. Knowledge of material characterization techniques is beneficial, but not a requirement.

Educational objectives

The students are given the opportunity to expand their knowledge in the field of aluminum alloys, LPBF process, mechanical tests

Literature

1. R. S. Mishra and S. Thapliyal, "Design approaches for printability-performance synergy in Al alloys for laser-powder bed additive manufacturing," *Materials and Design*, vol. 204, Jun. 2021, doi: 10.1016/j.matdes.2021.109640.
2. M. Roscher, S. Balachandran, D. Mayweg, and E. Jäggle, "Development of Al-Ti-based alloys for laser powder bed fusion," *Additive Manufacturing*, vol. 47, Nov. 2021, doi: 10.1016/j.addma.2021.102315.

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