



Annual PhD Report - Year 2

Mehrdad Faraji

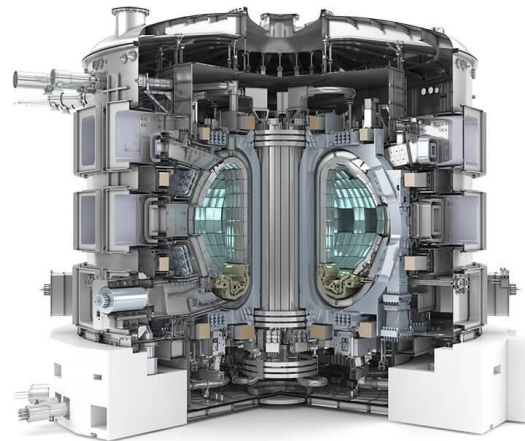
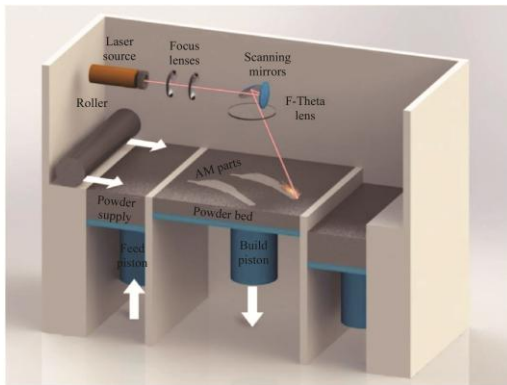
Supervisor: Irene Calliari

39th Cycle

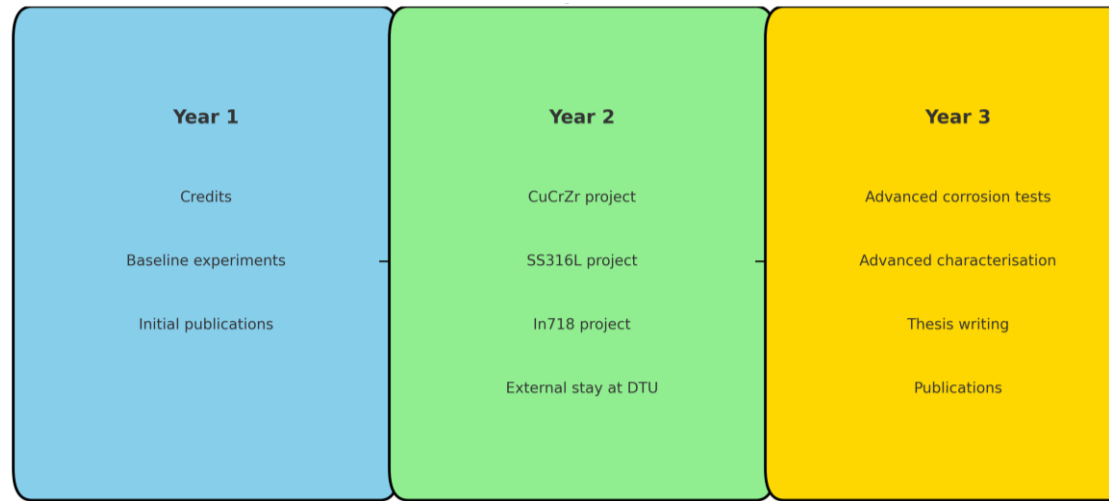
**PhD course of National Interest in Technologies for Fundamental Research
in Physics and Astrophysics**

Research Topic & Objectives

- ▶ Thesis title: Corrosion of components made by additive manufacturing for extreme applications
- ▶ Study build orientation effects on corrosion
- ▶ Investigate heat treatment effects on AM alloys
- ▶ Correlate printing condition with corrosion/erosion behavior



Overall PhD Plan (3 Years)



- SS316 fabrication with different build angle
 - SS316 characterisation
 - Electrochemical experiments
- CuCrZr fabrication with different build angle
 - CuCrZr characterisation
 - Electrochemical experiments on Cu alloys
 - Fabrication of IN718 using LPBF
 - Applying heat treatment
 - Characterisation after heat treatment
- Corrosion test in molten salt
 - Materials characterisation after corrosion



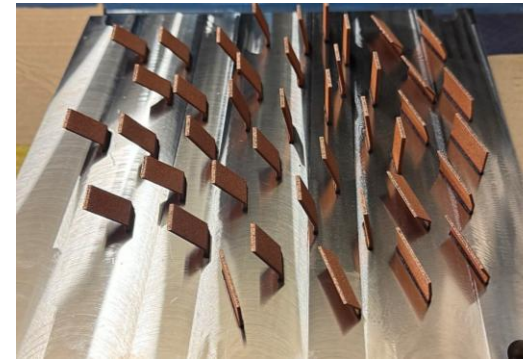
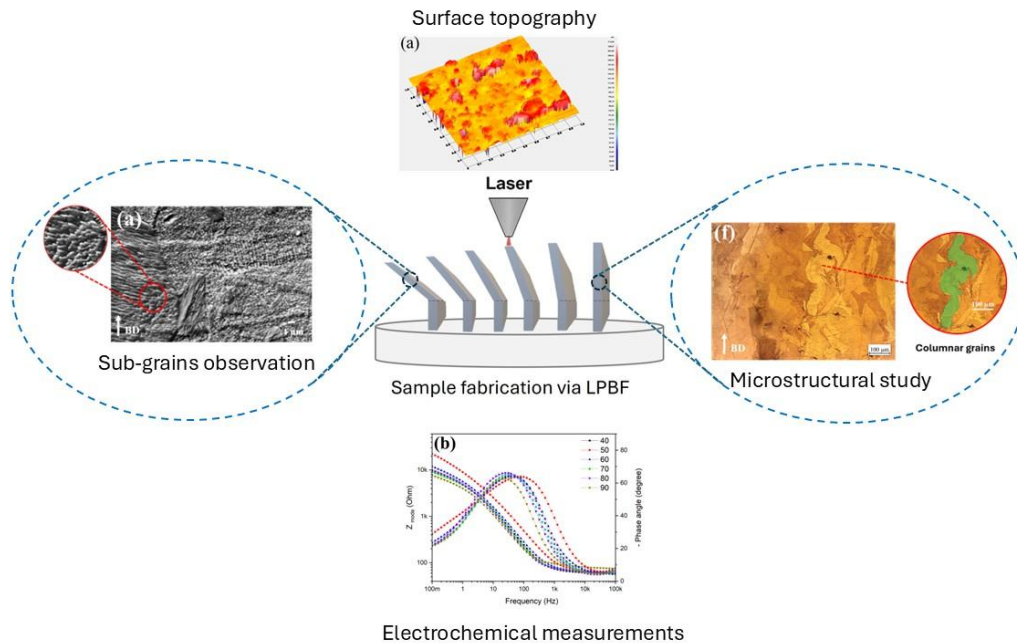
To-Do List for Second Year

1. Finalize the literature review plan. ✓
2. Develop the experimental protocol for material preparation and characterization. ✓
3. Procure materials and set up the 3D printing facility. ✓
4. Begin material preparation and initial characterization. ✓
5. Set up the testing environments according to ITER NBTF and thermal storage system simulations. ✓
6. Conduct the corrosion/erosion tests and collect data. ✓
7. Analyze the data and identify key findings. ✓
8. Draft the manuscript for publication. ✓
9. Submit the manuscript for peer review. ✓



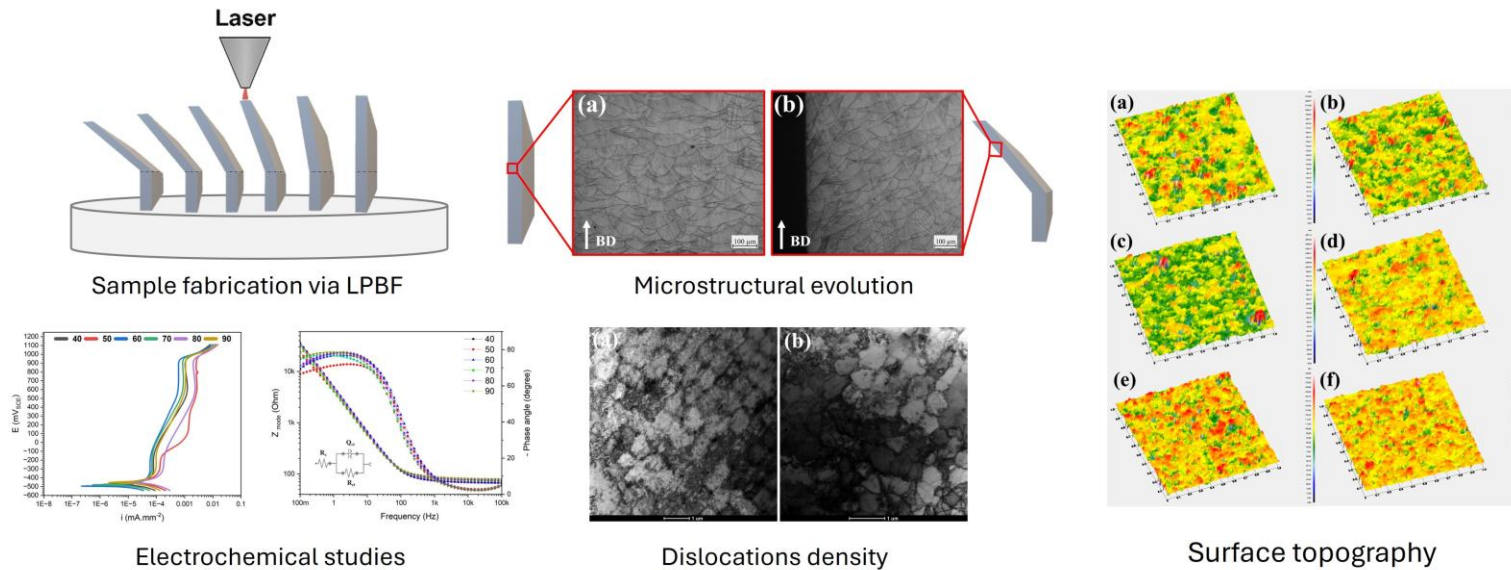
Research Year 2 - CuCrZr

- ▶ Electrochemical experiments with different build orientations
- ▶ Characterization: OM, SEM, surface topography
- ▶ Next step: Metal release test for erosion-corrosion performance



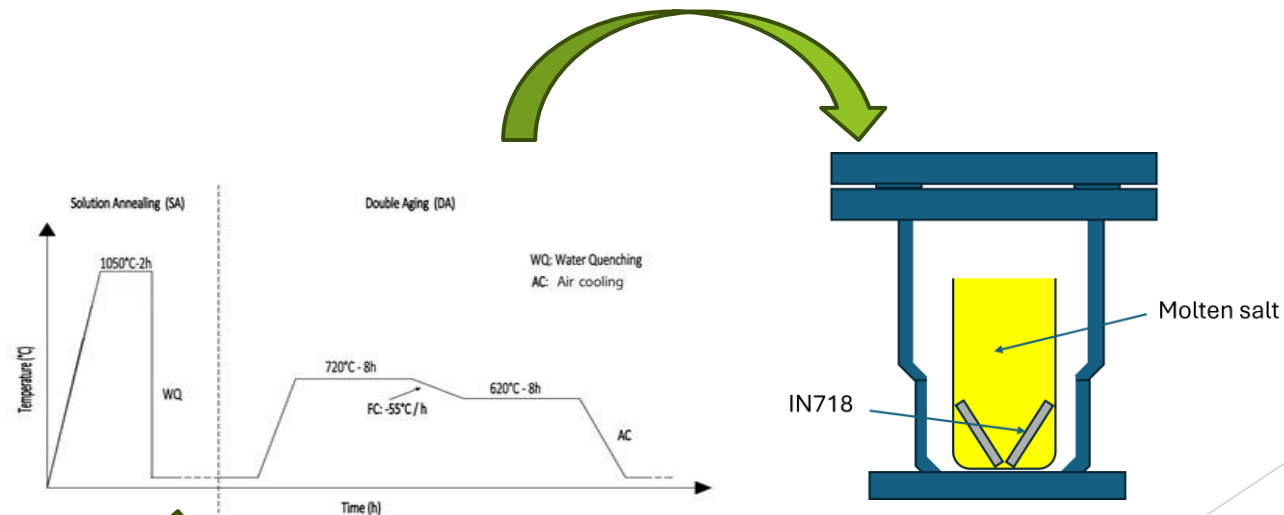
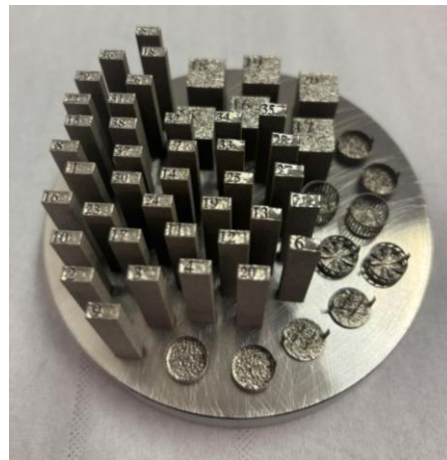
Research Year 2 - SS316L

- Comprehensive corrosion study under different build orientations
- Observed differences in passive film stability
- Next step: Up-skin and down-skin corrosion study



Research Year 2 - In718 (LoCoMoSa Project)

- ▶ AM In718 produced by LPBF, two heat treatments applied
- ▶ Characterized with OM, SEM, XRD
- ▶ Next step: Exposure in solar salt & post-corrosion characterization





Academic Achievements

- Conferences:
- - Gran Sasso Conference (Feb 2025)
- - AIM Conference (Sep 2024)
- - Kick-off Meeting
- Publications: 3 published, 2 under review

1- Faraji, Mehrdad, Luca Pezzato, Arshad Yazdanpanah, Giacomo Nardi, Mojtaba Esmailzadeh, and Irene Calliari. "Effect of Natural Inhibitors on the Corrosion Properties of Grade 2 Titanium Alloy." Materials 17, no. 21 (2024): 5202. **Published**

2- Faraji, M., L. Pezzato, A. Yazdanpanah, I. Calliari, and M. Esmailzadeh. "Effect of natural inhibitors on the corrosion properties of titanium and magnesium alloys." La Metallurgia Italiana (2025): 28. **Published**

3- Hosseini, H., S. G. Shabestari, H. Saghafian, M. Faraji, and M. Ghanbari. "Effect of Manganese on the Microstructure, Mechanical Properties and Corrosion Behavior of Mg–1Zn–0.3 Ca–0.3 Sr–x Mn Alloy." Metallurgical and Materials Transactions B (2025): 1-19. **Published**

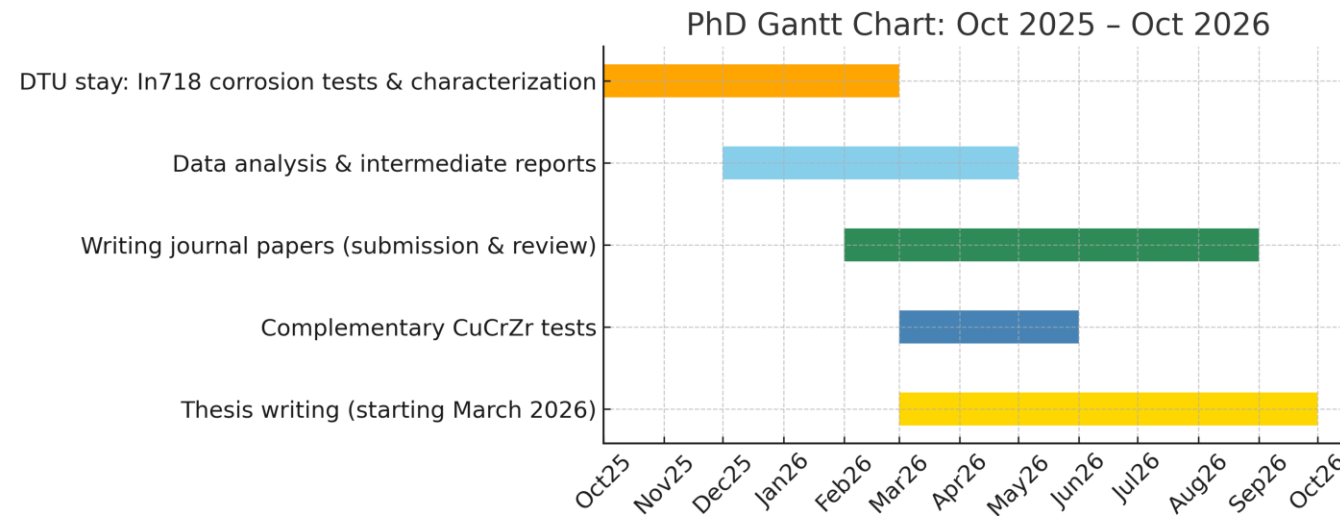
4- Mehrdad Faraji, Arshad Yazdanpanah, Massimiliano Bonesso, Razvan Dima, Adriano Pepato, Irene Calliari, Orientation-Dependent Surface Topography, Microstructural Characteristics and Corrosion Behavior of Additively Manufactured CuCrZr Alloy, **Under review**

5- Mehrdad Faraji, Arshad Yazdanpanah, Massimiliano Bonesso, Leonardo Salvo, Razvan Dima, Adriano Pepato, Irene Calliari, Effect of build orientation on the surface topography, microstructure and corrosion properties of additively manufactured SS316L, **Under review**

6- Candela S, Rebesan P, Franceschi M, Pigato M, Faraji M, Boldrini S, et al. Hot isostatic pressing of additively manufactured tungsten–tantalum alloys: microstructural, mechanical, and thermal characterization. Int J Refract Met Hard Mater. **Under review**

Courses & Exams

- ▶ More than 10 credits achieved in Year 1
- ▶ 1 Summer School: Metal Additive Manufacturing
- ▶ PhD week:
 - ▶ Research, Intellectual Property, and Exploitation: The PhD Perspective
 - ▶ Thriving in Your Career Outside: Orienteering for PhDs in the Extra-Academic Jungle
- ▶ Italian language courses: A1 & A2 Levels





Thank you for your attention