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

Annual report

Name and surname: **Mehrdad Faraji**

Cycle and a.a.: **39th**

Supervisor: **Irene Calliari**

- **Research activity carried out during the year**

During my second year of PhD studies, my research activities were mainly focused on three interrelated topics within the field of additive manufacturing (AM) and corrosion/erosion performance of metallic alloys. The overarching aim of these studies was to better understand how process parameters, build orientation, and post-processing treatments influence the corrosion resistance and degradation behavior of additively manufactured alloys. The details of my progress are summarized as follows:

1- Corrosion/erosion performance of additively manufactured CuCrZr:

In this study an extensive electrochemical experiments were conducted on AMed CuCrZr samples which produced with different building orientation. Microstructural evaluation was performed using different method like OM, SEM. Surface topography was also investigated to understand the correlation between building angle and material properties.

Next steps: Corrosion/erosion evaluation using metal release test method.

2- The effect of build orientation on the corrosion behavior of AMed SS316 L.

In this research a comprehensive study and experiments were also conducted to



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investigate the corrosion performance of this alloy with different printing conditions.

Next step: Corrosion study of up-skin and down-skin

3- LoCoMoSa project (It is going to be performed during my external stay at DTU)

In this project, the effect of heat treatment on the corrosion properties of AMed In718 will be evaluated. For this purpose, Some In718 samples were produced using LPBF method and two different heat treatments were applied. After samples preparation, material characterization was carried out utilizing OM, SEM and XRD.

Next steps: Exposure in the solar salt and characterization after corrosion test

Throughout these projects, I faced certain challenges that affected the pace of progress. Limited access to specialized equipment, such as advanced erosion testing setups, and unexpected downtime due to LPBF machine breakdowns delayed some experimental activities.

- **List of attended courses and passed exams**

All required credits were achieved in the first year (10 credits and 1 summer school)

- **List of attended conferences, workshops and schools, with mention of the presented talks**

Gran sasso conference – Feb 2025

AIM conference – Sep 2024

Kick off meeting

- **List of published papers/proceedings**

1- Faraji, Mehrdad, Luca Pezzato, Arshad Yazdanpanah, Giacomo Nardi, Mojtaba Esmailzadeh, and



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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. Saghaian, **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**

- **Thesis title (even temporary)**

Corrosion of components made by additive manufacturing for extreme applications

Date, 21/08/2025

Signature

Mehrdad Faraji

Seen, the supervisor