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UNIVERSITÀ
DEGLI STUDI
DI PADOVA

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

Annual report

Name and surname: Mehرداد Faraji

Cycle and a.a.: 39

Supervisor: Irene Calliari

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

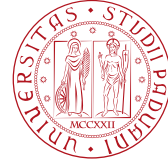
3D printing is revolutionizing the industrial sector by producing near net-shape components with the possibility - at the same time - of controlling the material chemistry and microstructure. This advanced manufacturing technique is being used on various alloys for different applications, one of the latest cutting-edge uses is in energy generation and storage for the much needed green energy transition. Corrosion testing and protection of 3D printed components for nuclear fusion reactors and thermal storage are being tackled in this project.

The aim of this work is to compare the corrosion/erosion performance of 3D printed alloys compared to the standard manufacturing procedures. 3D printed CuCrZr alloys are tested with the same water chemistry condition found in ITER NBTF systems and at same high velocity required (up to 12 m/s) and temperature (150 C) while 3D printed Ni alloys will be tested in contact with molten salts at the high temperature (550 C).

I've conducted research on the corrosion and erosion behavior of copper and nickel-based alloys, i have been writing a review paper to deepen my understanding, contributed to a paper for the AIM conference involving corrosion data analysis and simulations, worked on a paper about CuCrZr AMed alloy, and even got hands-on by printing stainless steel 316L samples to evaluate their properties.



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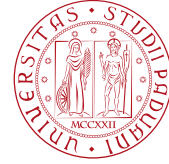
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- **List of attended courses and passed exams**
- Thermo-fluid dynamics in 3D printed channels
- Coupled electrical-thermal-structural finite element analyses
- Advanced scientific programming in MATLAB
- Fundamentals of systems engineering and project management for large-scale scientific projects
- **List of attended conferences, workshops and schools, with mention of the presented talks**
 - Research, Intellectual Property, and Exploitation: The PhD Perspective
 - Thriving in Your Career Outside: Orienteering for PhDs in the Extra-Academic Jungle
- Summer School: Metal Additive Manufacturing (Bertinoro-2024)
- Italian language course A1



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- **List of published papers/proceedings**

- Mehrdad Faraji, Luca Pezzato, Arshad Yazdanpanah, Mojtaba esmailzadeh, Irene Calliari Effetto degli inibitori naturali sulla resistenza alla corrosione delle leghe di titanio e magnesio (Effect of natural inhibitors on the corrosion properties of titanium and magnesium alloys), AIM conference 2024, Naples.
- M. Bonesso, M. Lago, G. Favero, P. Rebesan, M. Faraji, M. Franceschi, A. Campagnolo, G. Meneghetti, S. Mancin, A. Friso, A. Pepato, R. Dima, I. Calliari, Thermo-mechanical characterisation of the CuCrZr alloy produced via LPBF
- M. Faraji a,b, M. Bonesso, I. Calliari, A. Pepato, Advancements in Multi-Material Additive Manufacturing: A Review on Copper-Based Alloys (proceeding)

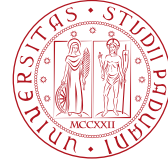
- **Thesis title (even temporary)**

- Corrosion of components made by additive manufacturing for extreme applications

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Date, 2024/09/07

Signature

Seen, the supervisor