UNIVERSITÀ
DEGLI STUDI
DI PADOVA

Admission to second year

Technologies for fundamental research in phisycs and astrophisycs

Mehrdad Faraji

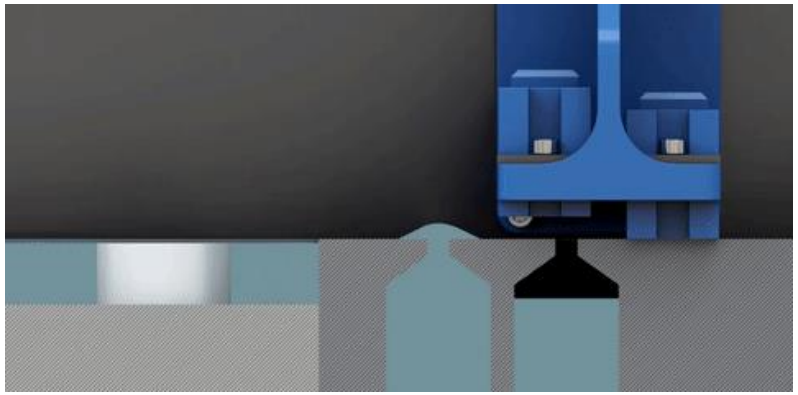
A.Y. 2023-2024

Table of Contents

PhD program

- **TOPIC**: Corrosion of components made by additive manufacturing for extreme applications
- **CURRICULUM**: Meccanica
- **HOSTING UNIVERSITY/RESEARCH CENTRE**: Università degli Studi di Padova / INFN sezione di Padova
- **SUPERVISOR(S):** Irene Calliari, Adriano Pepato

  Co-Supervisor: Massimiliano Bonesso



CuCrZr Alloy → corrosion/erosion performance 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)

Ni-Based Alloy → Corrosion behavior in molten salts at the high temperature (550 ˚C)

Laser Powder Bed Fusion → **AMed Samples** → **Corrosion/ erosion evaluation**

Initial Challenges and Adaptation

- Due to visa delays, I spent the initial three months in Iran.
- Despite the distance, I actively engaged in online courses, including an Italian language course, preparing myself for my move to Padova.

UNIVERSITÀ DEGLI STUDI DI PADOVA

ATTESTATO DI PARTECIPAZIONE
CERTIFICATE OF ATTENDANCE

Si attesta che

Faraji Mehrdad

nel mese di febbraio 2024 ha frequentato con profitto
presso il Centro Linguistico di Ateneo dell'Università di Padova
27 ore di un corso di lingua italiana di 30 ore di livello A1
per il potenziamento delle abilità comunicative orali.

This is to certify that the above-mentioned student
profitably attended 27 hours of a 30-hours Italian language course
(A1 level) for the enhancement of the oral communication skills
at the University of Padua Language Centre, in February 2024.

Padova, 14-MAR-24

Il docente di riferimento per la lingua italiana L2 al CLA
Professor responsible for Italian language L2 at the CLA
Prof. Tobia Zanon

CENTRO LINGUISTICO DI ATENEO

Coursework Achievements

Completed four PhD courses totaling 8.5 credits:

- 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

Additional Educational Activities

Successfully completed two PhD week courses totaling 2 credits:

- 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)

Research Contributions

- Conducted research on the corrosion and erosion behavior of copper and nickel-based alloys.
- Authored a review paper on my thesis topic 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.
- Printed stainless steel 316L samples to evaluate their properties.

The second year road map

1: Literature Review and Methodology Development

- Conduct an extensive literature review on 3D printing techniques, corrosion/erosion studies, and materials science relevant to nuclear fusion and thermal storage.
- Develop or refine experimental methodologies for evaluating corrosion/erosion resistance of 3D printed alloys under simulated ITER NBTF and thermal storage conditions.

2: Material Preparation and Characterization

- Procure raw materials for 3D printing (CuCrZr and Ni alloys) and conventional manufacturing processes.
- Design and print test specimens using 3D printing technology, ensuring quality control and adherence to specifications.
- Perform initial characterization tests (e.g., density, porosity, microstructure analysis) on both sets of samples.

The second year road map

3: Experimental Testing

Set up the testing environment to simulate the conditions in ITER NBTF systems for CuCrZr alloys (water chemistry, high velocity, and temperature).

Set up the testing environment for Ni alloys in contact with molten salts at high temperatures.

Conduct corrosion/erosion tests on both sets of samples, collecting data on material degradation over time.

4: Data Analysis and Interpretation

Process and analyze the experimental data, comparing the corrosion/erosion rates and mechanisms observed in 3D printed vs. conventionally manufactured alloys.

Identify any correlations between sample characteristics (e.g., microstructure, porosity) and corrosion/erosion performance.

Draft initial findings and discuss potential implications for the application of 3D printed alloys in nuclear fusion and thermal storage contexts.

The second year road map

5: Reporting and Publication

Compile all research data, methodologies, and analyses into a coherent narrative.

Write a manuscript detailing the methodology, results, discussion, and conclusion sections.

Submit the manuscript for peer review and consider revisions based on feedback.

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.

1222 • 2022
800
ANNI

UNIVERSITÀ
DEGLI STUDI
DI PADOVA

Thank you for your attention