PRUVO Jean-Baptiste

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Nuclear Material Science Post-Doctoral Researcher

Professional and academic background:

11/2023-05/2027: PhD at **CEA Saclay** - SRMP/JANNuS
Studying of ion irradiation and chloride molten salt corrosion in Nickel-based alloys
Supervisors: CABET Céline, LOYER-PROST Marie, GUTIERREZ Gaëlle, MALACARNE Romain

05/2023-09/2023: *Internship at* **CEA Cadarache** - IRFM/GCFPM
Developpement of hardness caracterisation of laser-annealed tungsten for fusion application
Supervisors: RICHOU Marianne, KERMOUCHE Guillaume, DURIF Alan

2022-2023: Material Science Master at Engineering school **Mines de Saint-Étienne**

2020-2023: *Engineering degree at Engineering school* **Mines de Saint-Étienne** including a 6 months long ERASMUS at **RWTH Aachen University**
Material and thermodynamic specialisation

Communications :

PhD Communications : *Advancement of understanding of irradiation effects on the corrosion of model Ni-based alloys in a molten chloride salt*

- **06/2026:** Poster at **IBMM 2026**
- **12/2025:** Oral at **TMS MiNES 2025**
- **04/2025:** Poster at **SMINS-7 2025**
- **10/2024:** Oral at **IBAF 2024**

Intership Communication: A laser-based annealing methodology to speed-up the study of thermo-activated restoration mechanisms in metals.

- Lemetais M., Pruvo J-B. *et al*, **ReV. Sci. Instrum**, **2025**

Skills:

- Mechanical sample preparation
- Electropolishing
- FIB sample preparation
- High temperature gloves box manipulation
- Vickers Hardness test
- **SEM:** Observation and EDS
- **TEM:** Loop observation and analysis
- **Languages:** French (mother tongue), English (B2)
- **Python**: Data analysis and represation, script developement, basic modelisation, image processing
- **SQL:** basic database creation and manipulation
- **Excel:** Data analysis, VBA Development- Latex writing
- Inkscape, Gimp and image processing

References:

- **CABET Céline**, CEA Research director, deputy head of service celine.CABET@cea.fr
- **LOYER-PROST Marie**, CEA Research asociate, head of laboratory marie.LOYER-PROST@cea.fr
- **BECHADE jean-Luc**, CEA Research director, former head of laboratory jean-luc.BECHADE@cea.fr
- **GUTIERREZ Gaëlle**, CEA Research asociate, deputy head of laboratory gaelle.GUTIERREZ@cea.fr
- **MALACARNE Romain**, CEA Research asociate romain.MALARCANE@cea.fr
- **KERMOUCHE Guillaume**, EMSE PhD Professor, Head of Departement kermouche@emse.fr
- **RICHOU Marianne**, CEA Research director, head of laboratory marianne.RICHOU@cea.fr
- **DURIF Alan**, CEA Research asociate alan.DURIF@cea.fr
- **Christien Frédéric**, EMSE PhD Professor frederic.christien@mines-stetienne.fr

Hobbies:

Video games Photography Hiking

PhD Work: Advancement of understanding of irradiation effects on the corrosion of model Ni-based alloys in a molten chloride salt

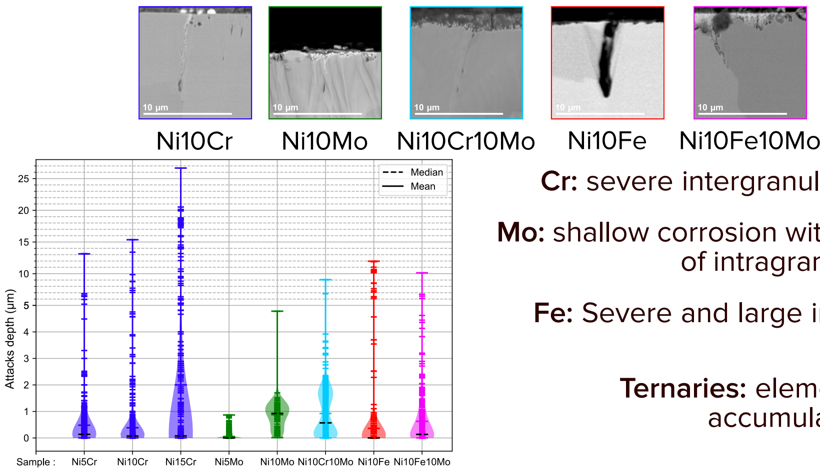
For Molten Salt Reactors (MSRs), the choice of structural materials remains a major challenge, particularly with regard to their resistance to corrosion resistance at high temperature and under irradiation. Corrosion mechanisms in a molten chloride environment under irradiation are complex and of great interest to the scientific community. While irradiation generally accelerates corrosion kinetics [1-5], under certain conditions, the possibility of partial healing by irradiation was suggested [6-8].

This PhD work is conducted within the framework of the French *Innovative System for Actinides Conversion* project and focuses on investigating the coupling mechanisms between molten salt corrosion and irradiation. A methodology to experimentally study the effect of pre-irradiation on molten salt corrosion has been developed. It was used in studies of corrosion, irradiation, and pre-irradiation followed by corrosion, that have been carried out on model nickel-based alloys (Ni10Cr, Ni10Fe, and Ni10Mo, Ni10Cr10Mo %at.) in order to study the specific effects of each alloying element.

Corrosion campaigns have revealed that each of these elements is associated with a different corrosion morphology and that these effects accumulate.

Figure 1:

Purified NaCl-$MgCl_2$ - 600°C
Glove box under Argon - 20h



Cr: severe intergranular corrosion

Mo: shallow corrosion with apparition of intragranular attacks

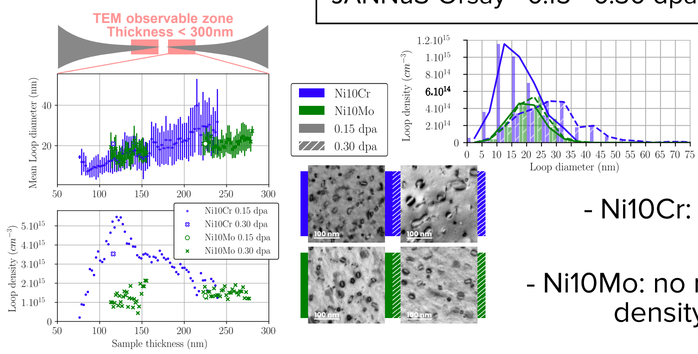
Fe: Severe and large intergranular attacks

Ternaries: elements' effects accumulate together

An irradiation campaign has shown a potential strong effect of free surfaces on dislocation loop density, likely due to the high temperature, and a different evolution of the loop density with increasing dose between Ni10Cr and Ni10Mo.

Figure 2:

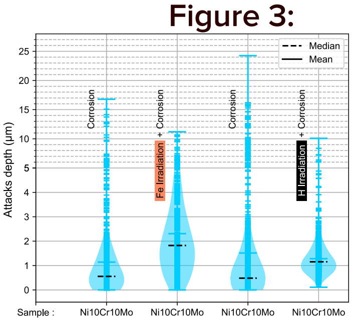
Nickel 2 MeV	4×10^{11} at/cm²/s	600°C
JANNuS-Orsay	0.15 - 0.30 dpa	TEM Samples



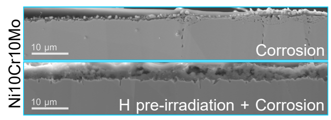
- Interstial dislocation loops
- Neither precipitation nor segregation observed
- Ni10Cr: start of coalescence at 0.30 dpa
- Ni10Mo: no major evolution of loop density distribution with dose

Finally, corrosion of pre-irradiated samples has shown a **homogenization of intragranular attacks** and **mitigation of intergranular attacks** in Ni10Cr10Mo in the pre-irradiated samples.

Figure 3:



JANNuS-Saclay 600°C Electropolish bulk samples	Iron 10 MeV 2.4×10^{10} at/cm²/s
	Proton 2.8 MeV 1.2×10^{12} at/cm²/s



Purified NaCl-$MgCl_2$
Glove box under Argon
600°C - 20h

[1] DiStefano et al., ORNL/TM-12925/R1 (1995)
[2] Bakai A. S. in Materials issues for generation IV systems: status (2008)
[3] Lei G et al, Corrosion Science (2020)
[4] Liu M. et al, Corrosion Science (2019)
[5] Zhu H. et al, Corrosion Science (2017)
[6] Zhou W. et al, Nature Communications (2020)
[7] Zhou W. et al, Nucl. Inst. Methods B (2019)
[8] Ezell N.D.B. et al, Nuc. Eng. Technol. (2021)

Internship Work: Hardness caracterization of gradient annealed tungsten samples

The ITER project requires the development of new technologies. Here, we will focus on one of them: the divertor. The divertor, located in the lower part of the tokamak's vacuum chamber, is the component subjected to the highest thermal stress. This is because it is in direct contact with the particle fluxes from the plasma. It has a dual role: it must allow for the extraction of a material flux (particles) and a thermal flux. On ITER, the expected heat fluxes range from 5 to 10 MW/m^2 in steady state [1]. At the IRFM, the WEST tokamak was developed to qualify and study the behavior of components when exposed to ITER divertor plasmas in a tokamak environment, as well as the impact of using these components on plasma stability. The ITER-like divertor is an assembly of PFUs (Plasma Facing Units) composed mainly of tungsten, which is being tested and developed using WEST at the IRFM.

The aim of the internship was to develop the hardness component of a new method for characterizing the recrystallisation kinetics of tungsten at high temperatures. The method involves the inhomogeneous annealing of a tungsten rod. The rod is subjected to a temperature gradient caused by heating one of its ends with a laser, which consequently creates a gradient in the rate of tungsten recrystallisation along the rod [2] (figure 1).

Hardness measurements along the bar enable the rapid generation of around a hundred triplets of time, temperature and recrystallisation rate, which are linearly correlated with the local hardness measurement (figures 1 and 2). This then allows the use of JMAK-type models to effectively study the recrystallisation kinetics of tungsten [2] (figure 3).

Figure 1:

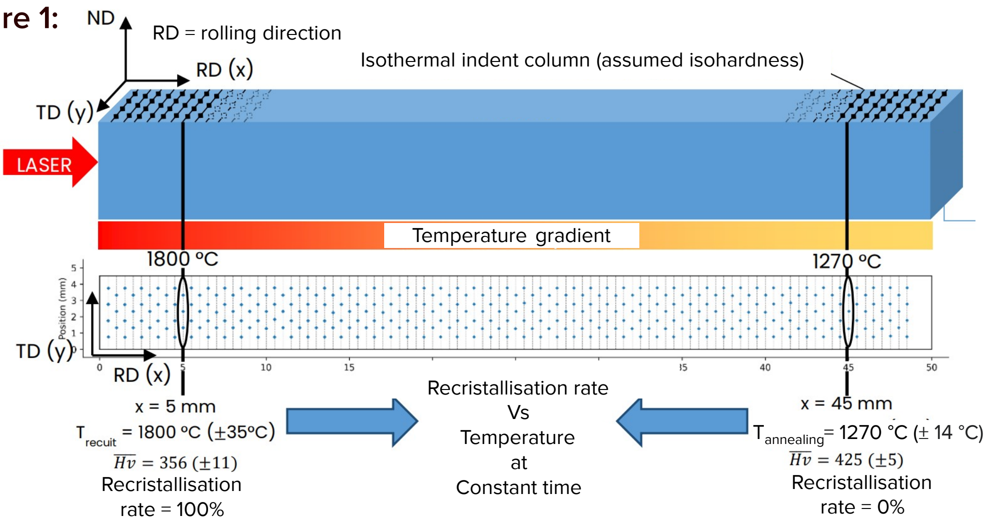


Figure 2: [2]

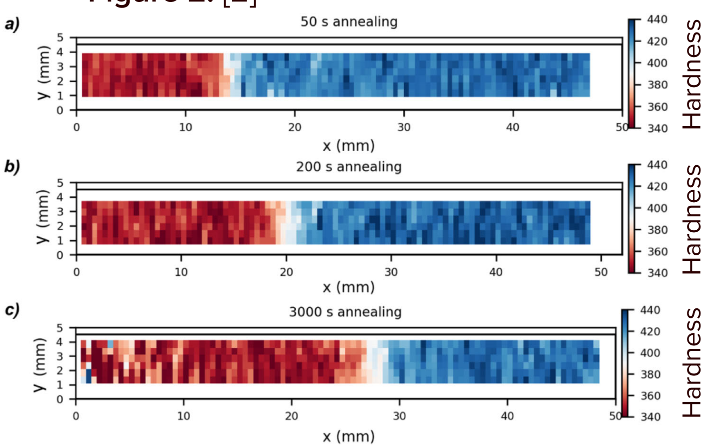
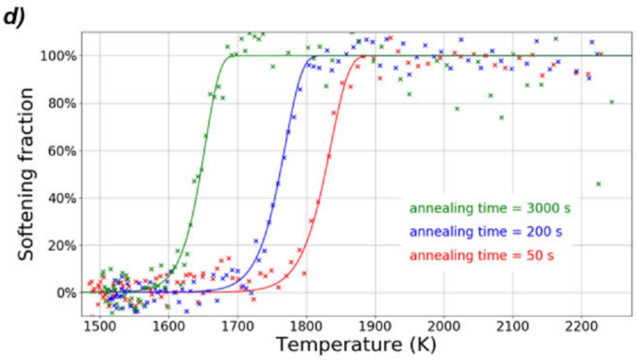


Figure 3: [2]



[1] Richou et al., Technique de l'ingénieur (2020)
[2] Lemetais, Pruvo et al, ReV. Sci. Instrum, (2025)