



Master 2 internship: Turning Aluminium Waste into High-Performance Parts Via a New 3D Printing Technology

Groupe de Physique des Matériaux (GPM) UMR 6634, Saint Etienne du Rouvray <https://gpm.univ-rouen.fr/>
Supervisors: Williams Lefebvre (williams.lefebvre@univ-rouen.fr)
Théo Duchateau (theo.duchateau@univ-rouen.fr)

This ambitious project is at the core of new technologies to be used to reduce the environmental footprint of metal production. The innovative approach proposes to combine scrap recycling and fast solid state metal transformation via Additive Friction Stir Deposition (AFSD). This project is a collaboration between 2 French groups ([GPM-Rouen](#) and [IRCP Paris](#)) and an Australian group ([Institute for frontier materials](#)) at [Deakin University](#). The master 2 internship will be hosted by GPM from February to July 2027 and in oct. 2027, a PhD will be granted by the University of Deakin.

AFSD¹ is a new high-throughput, solid-state “3D printing” process that builds metal parts without melting. In AFSD, a feedstock bar is rotated, generating heat through friction so the material plastically deforms; a translation motion then deposits it layer-by-layer while remaining in the solid state. This makes AFSD a powerful route for low-energy, low-emission manufacturing and opens new pathways for circular aluminium production. But many obstacles need to be overcome before the new methodology is optimized and can be adopted and for this purpose, multiscale characterisation of microstructures and properties need to be performed.

A key objective is to understand how the high strain, intense shear and elevated temperature of AFSD can break up and redistribute embrittling phases (oxides and Fe-rich intermetallics)², so that they are no longer detrimental to the properties of the recycled material. Characterisation will include SEM/EBSD (grain structure and defects), and advanced nanoscale tools such as Atom Probe Tomography (APT) and high-resolution Transmission Electron Microscopy (TEM) to understand oxide/intermetallic distributions and their role in performance. Characterization performed at GPM will be discussed during meetings with partners of the project at Deakin and IRCP.

GPM (CNRS - University of Rouen Normandy – INSA Rouen)

GPM, situated 1,5 hours from Paris, offers state-of-the-art TEM/SEM and atom probe tomography (APT) (plus FIB and unique tools such as [SATMET](#)³) to resolve precipitation, defects and recrystallisation mechanisms at the finest scales. Among the 150 people of the group, the project will fall in the activities of the team “Microstructure and Phase transformations”.

In the continuity of this project, a candidate for a granted PhD position will be selected

The successful PhD candidate will be primarily based at Deakin University (Australia), where the AFSD facility is located, while also spending time at GPM Rouen for advanced microstructural characterisation, particularly high-resolution TEM and Atom Probe Tomography. A prior successful internship at GPM on this topic will hence be an advantage.

The PhD offers a unique opportunity to work across leading research environments: the Institute for Frontier Materials, Deakin University in Australia, with a unique platform of innovative elaboration and transformation facilities - the IRCP (Institut de Recherche de Chimie Paris) for its expertise in the



recycling of alloys – the GPM, University of Rouen Normandy in France, at the front of advanced multiscale characterization of materials.

Profile of the candidate: The intern should enjoy working as part of a team to liaise with the various project stakeholders, have an interest in experimental science, and possess proven knowledge of physical metallurgy and microstructural characterization techniques.

Contacts:

Prof. Williams Lefebvre: williams.lefebvre@univ-rouen.fr

A/Prof Thomas Dorin: Thomas.dorin@deakin.edu.au

Dr Lola Lilensten: lola.lilensten@chimieparistech.psl.eu

Dr Theo Duchateau: theo.duchateau@univ-rouen.fr

(1) *Mater. Sci. Eng. A* **2026**, 970, 150423. <https://doi.org/10.1016/j.msea.2026.150423>

(2) *J. Alloys Compd.* **2025**, 1010, 178178. <https://doi.org/10.1016/j.jallcom.2024.178178>

(3) *Nat. Commun.* **2024**, 15 (1), 9870. <https://doi.org/10.1038/s41467-024-54169-2>