Institut de Recherche Technologique
Matériaux Métallurgie et Procédés

R&D engineer – POST DOCTORAL position
Toulouse (31)

KEYWORDS: Aluminium ; Corrosion ; Trivalent chromium conversion; Microstructure ; Electrochemistry

1. Présentation of the company and its partners

The IRT M2P *is a shared research centre set up in June 2013, bringing together industrial companies and research and higher education establishments, and focusing on advanced technologies for the elaboration, transformation and characterisation of materials. Organised into 3 areas of activity (Elaboration, Surface Treatment and Coating, Composites & Assembly), it currently employs over 100 people at 4 sites (Metz, Porcelette, Uckange and Duppigheim).*

Le CIRIMAT *(Centre Inter-universitaire de Recherche et d'Ingénierie des Matériaux) is a Joint Research Unit (UMR CNRS INPT UT3 5085) with around 220 staff, excluding trainees, including just over 100 permanent staff, 75 PhD students and 35 post-doctoral students, ATERs and contract engineers. It was created in 1999 by the merger of 3 laboratories and has been structured into 6 teams since January 2021. It brings together Toulouse's expertise in materials science and engineering, spread over 4 geographical sites: 3 on the Toulouse-Rangueil University campus (UT-Chimie, UT-Physique, UT-Pharmacie) and one on the INPT-ENSIACET campus. The MEMO team at Cirimat (Mechanics - Microstructure - Oxidation - Corrosion) aims to maintain the highest possible level of expertise in solidification, solid-state phase transformations, plasticity and mechanical behaviour, high-temperature oxidation and protection, corrosion and stress corrosion.*

2. Context and objectives:

The APOLLO (Aluminium Protection through conversion without harmfuL hexavaLent chromium) project in which this post-doctorate is involved concerns the optimisation of the chemical conversion process applied to aluminium alloys used in the aerospace sector. The project has two main objectives: to improve the performance (particularly the robustness) of CrIII/Zr-based chemical conversions and to continue developing a Cr-free process. Historically, the aerospace industry used a chemical conversion process based on hexavalent chromium, the use of which has been banned in Europe since September 2017 without authorisation. This ban has led the aerospace industry to research and develop new processes that are more respectful of the environment and employee health. As a result, emerging CrIII/Zr-based processes have emerged over the last 20-30 years and have been the subject of much research work with a view to meeting the sector's requirements (improving alloy corrosion resistance, maintaining electrical resistivity below 5 mΩ, compatibility with painting). However, to compensate for the lack of robustness of this new treatment (in terms of corrosion resistance in particular), work to understand surface preparation (major impact on anti-corrosion performance) prior to chemical conversion was initiated as part of the APOLLO project. An alternative to the complete use of chromium for chemical conversion is also envisaged with the continuation of work on a chromium-free formulation with or without post-treatment. The aim of this post-doctorate will be to gain a better understanding of the role of surface preparation on the evolution of the microstructure of aluminium alloys and the corrosion resistance of conversion layers formed using commercial CrIII/Zr-based processes.

Objectives :

The aim is to analyse in detail the interactions between alloy microstructure and the corrosion resistance of conversion layers. The study will aim to contribute to the optimisation of surface preparation steps to improve the corrosion resistance of conversion layers. The work will focus in particular on alloy 2024 in the form of thin sheets (T3 condition) and thick sheets (T351 condition), which have microstructural differences such that, in general, the Cr III / Zr IV conversion layers perform less well on sheets in the T351 condition. The aim will be to analyse the microstructure at the scale of coarse intermetallic particles and grain boundaries, and to study the impact of the differences observed between the two metallurgical states on surface properties after the preparation stages prior to conversion treatment, in order to establish a link with the corrosion resistance of the conversion layers.

3. Job description du poste and profile sought

The candidate must hold a doctoral thesis related to the study of the relationship between the microstructure of metals and their properties. They will need to demonstrate strong expertise in the analysis and characterisation of surfaces and/or corrosion phenomena, in particular through the use of the following techniques:

- Optical microscopy (OM), scanning electron microscopy (SEM), transmission microscopy (TEM) and atomic force microscopy (AFM);
- Electron Backscatter Diffraction (EBSD);
- X-ray energy dispersive spectroscopy (EDS) and electron energy loss spectroscopy (EELS);
- Electrochemical techniques: scanning electrochemical microscopy (SECM) and electrochemical impedance spectroscopy (EIS).

This 2-year position will be based in the CIRIMAT laboratory and will be available from early 2026, with occasional travel throughout France.

To send us your full application (CV with references and covering letter) before September 12, 2025:

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