

## PhD position at Reims Champagne-Ardenne University France

(from Anne-Lise Daltin, URCA, Reims, France )

SNI Doctoral School - Digital and Engineering Sciences  
Specialization in Materials Sciences, Surfaces and Interfaces  
Laboratory: Materials and Mechanical Engineering Research Unit (MATIM)  
Supervision of the thesis Anne-Lise DALTIN (al.daltin@univ-reims.fr)  
Co-Director Florica LAZAR (florican.lazar@univ-reims.fr)  
Financing from 03-10-2022 to 02-10-2025  
Start of the thesis on October 3, 2022

**Application deadline (at 11:59 p.m.) June 16, 2022 :**

<https://doctorat.campusfrance.org/CF202227099>

**Title : Surface structuring by magnetoelectrodeposition (SURFMED)**

**Key-words:** magnetoelectrochemistry; magnetic fields; surface structuring; wetting; sustainability ; heat exchange;

**Supervisor:** Anne-Lise DALTIN – Materials and Mechanical Engineering (MATIM) – al.daltin@univ-reims.fr

**Thesis co-director:** Florica LAZAR – Matériaux et Ingénierie Mécanique (MATIM) – florica.lazar@univ-reims.fr

### Description of the research problem:

#### Context and challenges

In the MATIM laboratory, we carry out fundamental and application-oriented research related to energy and environmental aspects in different research fields.

The SURFMED project is part of a program which aims to develop innovative functionalized surfaces by magneto-electrochemical methods and to investigate their performance and resistance to aging for electro and magneto wetting applications. The final application is aimed at increasing heat transfer at the millimeter scale.

Magneto-electrochemistry is used in this project to design super-hydrophobic patterns, especially for electro-wetting studies, with good permittivity control at the micro-scale of the deposit.

#### Scientific objectives

- Synthesis of formed coatings and understanding of nucleation and growth mechanisms under the effect of forces induced by magnetic fields. characterization (physico-chemical and electrochemical);
- Modeling of electrochemical processes considering magnetohydrodynamic flows;
- Determination of process – structure – property relationships through a multi-scale and interdisciplinary approach. The specific properties sought relate to the intended objective, namely the optimization of the cooling regimes;
- Evaluation of the durability of these coatings under operating conditions and study of their resistance to corrosion by electrochemical methods.

#### Methodology and implementation techniques

A first part will consist in defining the parameters necessary to obtain well-structured alloy coating morphologies and the analysis of the reactions involved. Parameters such as electrolyte compositions, temperature during electrodeposition, current densities, potential, pulsed mode deposition parameters will be defined. This task will include the study of nucleation and growth mechanisms by analyzing electrochemical curves and modelling the influence of MHD and  $\mu$ MHD forces.

A second part will include the morphological and structural characterization by SEM and XRD of the synthesized coatings and the roughness will be determined.

The surface properties of alloy coatings are important in determining the durability and aging of a deposit. Zeta potential measurements of the alloy coating will be performed to determine surface charge as a function of various synthesis parameters to optimize wettability. The anti-corrosion properties of the coatings will be analyzed in an

environment similar to their intended end use by measurements of corrosion potential, electrochemical impedance spectroscopy and physical analysis.

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**Profile and required skills:**

Engineer and/or master level - Good level of general and scientific knowledge. Good level of oral and written French and/or English. Good analytical, synthesis, innovation and communication skills. Qualities of adaptability and creativity. Motivation for research activity. Prerequisites (specific skills for this PhD thesis): Good knowledge of chemistry in general and solid-state physico-chemistry in particular. Knowledge of materials science and electrochemistry would be appreciated.

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**Contacts :**

The candidate is invited to contact the Scientific Manager of the PhD thesis subject (Anne-Lise DALTIN [al.daltin@univ-reims.fr](mailto:al.daltin@univ-reims.fr) ; Tel: +33(0)3 26 91 84 49 who will send the Doctoral School a reasoned opinion on his application.

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