Thesis offer

Start: Mai 2024

Subject:
SURFACE MODIFICATION AND PHYSICAL CHARACTERIZATION OF CONTROLLED OXIDE LAYERS GROWN ON STEEL ALLOYS FOR ELECTROCHEMICAL ENERGY CONVERSION

General informations

Place of work: Nancy **(IJL), IJL recruitment**
Type of contract: Thesis in CIFRE agreement
Contract duration: 36 months
Expected date of employment: May 2024
Work shift: Full time
Salary: 30000€/year (gross)
Desired level of study: Master's degree in physics or in materials science and engineering.
Desired experience: Good written expression in French and English. Interest in renewable technologies and the challenges of decarbonizing mobility.

Work context

In the context of electrochemical energy conversion systems, stainless steels have an important role thanks to their good performance in electrical and thermal conductivity, in mechanical drawing, in corrosion resistance and with a moderate cost.
However, these materials are far from being the ideal solution, especially from the point of view of durability. The decarbonization of heavy transport (trucks) will only succeed if the fuel cell can guarantee a lifetime of 15,000 hours.
For stainless steels to achieve this goal, surface treatments are required to enhance the resistance of the steel in contact with the cellular environment. The native oxide layer developed on stainless steel is known to not provide the necessary protection, but the precise causes are not yet fully understood. As an alternative to deposition treatments, chemical treatments of stainless steels in the liquid phase have been implemented and seem to give good results. In this thesis, we propose to explore alternative routes, such as controlled gaseous pre-oxidation.

Tasks / Activities

The thermochemical oxidation treatments will be carried out in different plasma reactors (space post-discharge, MDECR reactor) on different families of stainless steel. The modified surface layers will be characterized at IJL from a morphological (SEM, optical profilometry) and microstructural (DRX, MET, EBSD, GDOES, XPS) point of view and at Symbio for electrical conductivity and corrosion resistance.
In seeking to obtain high-performance layers for energy conversion, the doctoral student will above all have to produce layers of oxides with different properties in order to correlate the crystalline structure with the electrical conductivity. In addition, the electrical interaction between the oxide and the carbon-based materials will also be investigated. Finally, the most promising surface treatment will be tested on real components intended for use in a proton exchange membrane fuel cell stack.

Location of the thesis

The thesis will be done mainly at the Jean Lamour Institute but 10% of the thesis will be done at the Symbio laboratory.

Skills

- Master's degree in Physics (preferred) or in materials science. A specialization in interface physics would be a plus.
- Competence in electrical measurement tests.
- Able to work in close contact with industry.
- Fluency in French and English.

About the Jean Lamour Institute

The Jean Lamour Institute (IJL) is a joint research unit of the CNRS and the University of Lorraine. It is attached to the CNRS Institute of Chemistry. Specialized in science and engineering of materials and processes, it covers the following fields: materials, metallurgy, plasmas, surfaces, nanomaterials, electronics. The IJL has 183 researchers and teacher-researchers, 91 engineering, technical and administrative staff, 150 doctoral students and 25 post-doctoral students.
It collaborates with more than 150 industrial partners and its academic collaborations are deployed in around thirty countries. Its exceptional instrumental park is spread over 4 sites, the main one being a new building located on the Artem campus in Nancy.

About Symbio

Global technological partner of manufacturers in terms of hydrogen systems for mobility, Symbio has been equally owned by Faurecia and Michelin since November 2019. The company is participating in the acceleration of the deployment of hydrogen mobility, which is zero-emission by nature. Already a supplier to the Stellantis group, the company aims to become a world leader in hydrogen mobility by producing 200,000 StackPacks per year by 2030, for manufacturers around the world.

How to apply

Send CV and cover letter to:
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