

## Research Grants for PhD students from the China Scholarship Council

Information Form (please read the guidelines carefully on the website [www-csc.utt.fr](http://www-csc.utt.fr))

Supervisor's name : ALHUSSEIN Given names : Akram

Status (prof., assistant prof., ...): Associate Professor

Laboratory : ICD/ LASMIS Website address : <http://lasmis.utt.fr/en/index.html>

Institution : University of Technology of Troyes (UTT) Website address : <http://www.utt.fr/en/index.html>

Scientific competence of the supervisor:

Surface treatment, Coatings, Thin films, Mechanics of materials, Mechanical testing, Fatigue, Damage, Fracture.

Two major publications in the field proposed for the PhD :

1. Vincenc Nemanič, Hydrogen permeation barriers: Basic requirements, materials selection, deposition methods, and quality evaluation, Nuclear Materials and Energy 19 pp 451–457, 2019.
2. A. Alhussein, J. Capelle, J. Gilgert, S. Dominiak, Z. Azari, Influence of sandblasting and hydrogen on tensile and fatigue properties of pipeline API 5L X52 steel, Int Journal of Hydrogen Energy, pp 2291-2301, 2011.

Website address of the personal page : [https://www.researchgate.net/profile/Akram\\_Alhussein](https://www.researchgate.net/profile/Akram_Alhussein)

**Supervisor's email :** akram.alhussein@utt.fr

**Description of the research work proposed for a PhD** **Topic # (see list) :** V-5, IV-12

Title : Development of hydrogen barrier coatings to protect metallic structures used in energy sector.

Subject :

Hydrogen as an energy source could be an alternative to fossil fuels. Its development, however, faces major scientific, technological and economic challenges. In particular, since hydrogen is small, it penetrates into the crystalline sites of metallic materials and shortens their lifetimes. The objective of this project is to develop coatings of few micrometres thick to protect metallic structures damaged by hydrogen embrittlement (HE) used in different industrial sectors, particularly in the energy field. These structures correspond to the hydrogen production, transport and storage systems. The development of advanced coatings by combining barrier properties that are resistant to environmental conditions, hydrogen barriers and corrosion resistant, presents immense scientific and economic potential in the energy sector. The project revolves around several tasks:

- 1- Deposition of coatings: thin layers will be deposited by different technologies especially by magnetron sputtering.
- 2- Quantify the hydrogen amount adsorbed/absorbed in the reference and coated samples.
- 3- Characterizations of coatings: crystallographic analysis, morphological, physico-chemical and mechanical characterizations.
- 4- Study the effect of static and dynamic loading under hydrogen (tensile and fatigue tests) on the behavior of the material and its lifetime.

Keywords :

Surface treatment, thin films, coatings, hydrogen, protective barriers, PVD, functional materials, mechanical properties, X-ray diffraction, microstructure, physico-electro-chemical analysis, metallic and ceramic alloys.

Expected collaborations :

The candidate will have the opportunity to work in partner laboratories to perform some specific tests, observations and analyzes on the performance of material against hydrogen.

Background required from the applicant :

Applicant must have competences in Materials Science and Mechanical Engineering. The applicant must be rigorous, reliable, curious and innovative. He/she must keep a critical mind and be able to propose new ideas and solutions.

Existence of a PDF file detailing the proposal ("yes" or "no") : Yes

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