Research Grants for PhD students from the China Scholarship Council

Information Form (please read the guidelines carefully on the website www-csc.utt.fr)

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<thead>
<tr>
<th>Supervisor's name: Panicaud</th>
<th>Given names: Benoît</th>
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<tr>
<td>Status (prof., assistant prof., …): Full professor</td>
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<td>Laboratory: LASMIS</td>
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<td>Institution: UTT</td>
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<td>Website address: <a href="http://utt.lasmis.fr/fr/index.html">http://utt.lasmis.fr/fr/index.html</a></td>
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Scientific competence of the supervisor:

For supervisor 1:
- Micromechanics;
- Damage mechanics;
- Stress evolution during oxidation at high temperature;
- Metallurgy

For supervisor 2:
- Material Science;
- Oxidation at high temperature;
- Corrosion mechanisms;
- Stress release mechanisms;
- Raman Spectroscopy;
- X-Ray Diffraction

Two major publications in the field proposed for the PhD:

1. Mechanical features optimization for alpha-Cr2O3 oxide films growing on alloy NiCr30, Computational Material Science, 2009, Volume 46, Pages 42-48; B. Panicaud et al.
2. Experimental and numerical study of the effects of a nanocrystallisation treatment on high temperature oxidation of a zirconium alloy, Corrosion Science, 2012; B. Panicaud et al.

Website address of the personal page: [http://LASMIS.utt.fr/en/members/panicaud.html#top](http://LASMIS.utt.fr/en/members/panicaud.html#top)

Supervisor's email: benoit.panicaud@utt.fr

**Description of the research work proposed for a PhD**

**Topic # (see list):** IV-12

**Title:** 
Experimental study and multiscale modelling of mechanical features and damage evolution in thermal oxide films in order to predict their lifetime.

**Subject:**
The aim of the present project is to characterise the mechanical and degradation behaviour of oxides growing on metals during high temperature corrosion in aggressive environments. At a macroscopic scale, a general modelling is now available that enables to predict the evolution of internal stress with time in both the oxide and the metal, including damage relaxation. Because of its influence on the lifetime of such systems, generation and relaxation of stresses has to be understand at a precise level including its coupling with microstructure and also its evolution during the course of oxidation either isothermally or during cycling. Thus, a multi-scale modelling has also to be developed in agreement with the experimental investigations. Moreover, a validation is needed even at a microscopic scale (grain scale). In order to quantify the mechanical responses of the oxide layer and the metal substrate, different experimental approaches will be undertaken including e.g. X-Ray diffraction or Raman spectroscopy. These measurements enable to perform strain/stress mapping at a macroscopic or local scale. In addition, Atomic Force Microscopy is able to check microstructural features at a microscopic scale (grain scale). By studying the effect of thermomechanical loadings (thermal cycling and isothermal load), the model will be validated by comparing with the measurements and using a robust optimization process.

**Keywords:**
- residual stress mapping;
- creep relaxation;
- micromechanics in oxide layer;
- numerical simulation including damage (blistering...);
- dynamic measurements;

**Expected collaborations:**
This project will be managed in collaboration with Prof. Jean-Luc Grosseau-Poussard of University of La Rochelle. Experimental supports will be provided in both laboratories. Numerical supports will be provided by University of Technology of Troyes. Some specific experiments at Synchrotron facilities could be performed during the project.

**Background required from the applicant:**
- Material Science;
- Oxidation at high temperature;
- Corrosion;
- Damage mechanics;
- Micromechanics;
- Physical Metallurgy;

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

(see guidelines on the website www-csc.utt.fr)