

Research Grants for PhD students from the China Scholarship Council

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

Supervisor's name : FILLON Given names : Amélie

Status (prof., assistant prof., ...) : Assistant professor

Laboratory : Institute of "Sciences Chimiques de Rennes", ISCR, Chemical Metallurgy group (UMR CNRS Website address : <https://iscr.univ-rennes.fr/fr/equipe-chimie-metallurgie-c>

Institution : INSA Rennes, France Website address : <https://www.insa-rennes.fr/iscr-1.html>

Scientific competence of the supervisor:

Amélie Fillon, Assistant Professor at INSA Rennes conduct research on the film growth of metallic alloys by magnetron sputtering deposition and the characterization of their microstructural, physical and mechanical properties at different scales by various techniques (XRD, SEM, EBSD, TEM, AFM, nanoindentation, tensile and bending tests, fatigue, tribological tests). Her research interests concern the development of functional metallic coatings for biomedical applications (superelastic properties).

Two major publications in the field proposed for the PhD :

1. Y. Zhou, A. Fillon, H. Jabir, D. Laillé, T. Gloriant, Investigation of the superelastic behavior of a Ti-16Zr-13Nb-2Sn sputtered film by nanoindentation, Surf. & Coat. Technol 405 (2021) 126690.

2. T. Choquet, H. Chigama, G. Abadias, A. Michel, T. Gloriant, P. Vigneron, M. Vayssade, A. Fillon, Superelastic and biocompatible TiZrNbSn coatings deposited by magnetron sputtering, Surf. & Coat. Technol 494 (2024)

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Description of the research work proposed for a PhD

Topic # (see list) : IV-8

Title : Design of innovative graded functional coatings for biomedical applications

Subject :

The subject focuses on the development of novel bio-functional alloy coatings which will fulfil specific and practical requirements for their applicability on biomedical implantable devices. These coatings must satisfy both excellent biocompatibility and biomechanical requirements (low Young's modulus, high strength, excellent corrosion resistance, superelasticity). The work of the PhD student will consist in improving the functional and mechanical properties of the alloy coatings, especially their superelasticity, by varying the chemical composition and applying various thermal treatments. In addition, a strategy based on multilayer coatings with graded properties will be investigated in order to improve the adhesion, mechanical performance, and long-term durability of the coatings. Mechanical properties will be characterized by conventional and cyclic tensile tests, as well as nanoindentation in order to investigate local mechanical properties. A careful analyze of the microstructure will allow to determine the link between the processing route, the subsequent microstructure and mechanical properties. The texture will be analyzed by XRD and EBSD and the microstructure investigated in details by optical microscopy, SEM, EDS, AFM and TEM. Collaboration with the Soleil synchrotron radiation will allow to perform in situ tensile tests under X-ray synchrotron radiation. On the other hand, lifespan of these alloys will be characterized by fatigue tests and bending tests under different conditions.

Keywords :

coating, sputter-deposition, micro to atomic scale structural characterization, mechanical properties, residual stress

Expected collaborations :

Collaboration with research group expert in real time monitoring of film growth based on various in situ diagnostic (wafer curvature, electrical resistance, reflectance spectroscopy). Synchrotron radiation facilities to study the phase transformation under X-ray radiation and the resistivity change during mechanical test. Collaboration with biological laboratory to study the biocompatibility of the functional and metallic coatings (cytotoxicity, corrosion resistance, material-cell interactions).

Background required from the applicant :

Highly motivated candidates (master degree or equivalent) with a background in materials science and / or physics are strongly encouraged to apply. Previous laboratory experience in PVD process, metallic alloys, microstructural or mechanical characterization or specific skills in XRD, EBSD or TEM will be a plus. The interested candidate should have good written and oral communication skills as well as ability for team work.

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

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