

ITODYS lab., Université de Paris
<https://www.itodys.univ-paris-diderot.fr/fr/>

- Location: Paris, France
- Posting Date: January 5th 2022
- Application Deadline: Open Until Filled

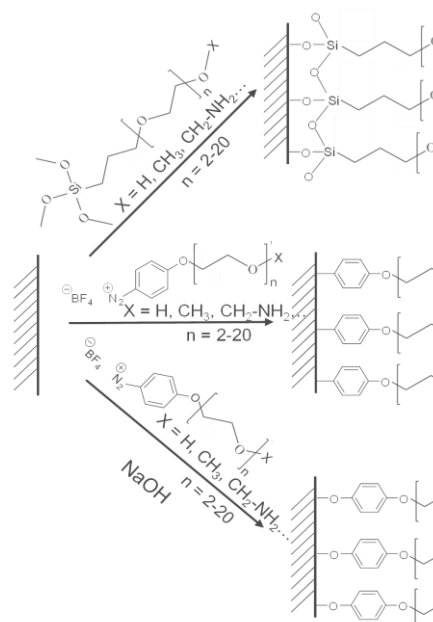
Job Description

Postdoctoral fellow/scholar position of 18 months is available immediately in a multidisciplinary team studying the surface chemistry of TiNbZr-X (X = Ta or Mo) complex concentrated alloys (CCAs) for bio-implant applications.

The aging of the population in our modern societies and the increased risk of bone disease or bone accident is continuously growing and the development of advanced bio-implant materials, particularly metal alloys, with a long-life cycle time is a significant public health issue. Up to now, the primary strategy for optimizing the mechanical performances of metallic materials has long been based on the adjustment of the chemical composition and the microstructure of conventional Ti alloys, even if their Young modulus (E) remains still higher than that of bone. Recently, the concept of complex concentrated alloys (CCAs) or high entropy alloys (HEAs) brings real hopes¹⁻³. It allows developing compounds with exceptional synergetic properties, such as specific strength, corrosion resistance together, in some cases, with a low E value².

In this context, high potential TiNbZr-X (X = Ta or Mo) CCAs are addressed with a special emphasis on their chemical surface engineering to improve the acceptability of the implant by the body, in which it is inserted.

The present project wants to focus on 1) the chemical/electrochemical oxidation and 2) the chemical grafting of polyethyleneglycol (PEG) derivative chains (short, medium, or long) using silane chemistry⁴ and/or diazonium salt chemistry⁵. In practice the surface oxidation layer will be characterized in terms of structure and microstructure as a function of the alloy environment nature and contacting time (accelerated chemical/electrochemical corrosion or long passive one), also the PEG-based organic coating will be characterized in terms of surface covering, grafting density, bonding robustness, etc. as a function of the grafting operating conditions. The capability of such a coating to prevent corrosion, improve water wettability, and adsorb this or this type of proteins, in relation to osteoblast cell adhesion and proliferation, will be typically investigated.



General scheme of the PEGylated silane and aryl diazonium derivative grafting.

All these activities will be performed at ITODYS laboratory, which is a CNRS and *Université de Paris* research unit (located in Paris - France). ITODYS is well known as an expert academic research center in the study of surfaces and interfaces involving multidisciplinary expertise, both experimental and numerical approaches for both basic and applied knowledge. Projects on nanomaterial synthesis and shaping, chemical surface engineering, material and

surface characterization, supramolecular chemistry, nano and nano-biotechnologies, etc. are typically addressed.

The recruited young scientist, will thus contribute to the chemical/electrochemical corrosion assays on the processed/machined CCA alloys, their physico-chemical characterization and their coating through optimized chemical strategies by a thin PEGylated polymer film, evaluating the protective capability of the formed films. He/she will have a full access to all the lab's elaboration and characterization facilities (XPS, SEM-TEM, ATR-FTIR, Raman, AFM-STM, XRD-GiXRD, Ellipsometry, electrochemistry platform, including impedance spectroscopy among others. He will be also involved in mechanical tests (scratching, nanoindentation...) to evaluate the adhesion strength of the film on the coated alloys.

References

1. O. N. Senkov et al., *Mater. Sci. Eng. A* 2011, 529, 311.
2. J.-P. Couzinié et al., *Data Brief* 2018, 21, 162.
3. Y. Okazaki, *Curr. Opin. Solid State Mater. Sci.* 2001, 5, 45–53.
4. G. J. Owens et al., *Prog. Mater. Sci.* 2016, 77, 1.
5. S. Mahouche-Chergui et al., *Chem. Soc. Rev.* 2011, 40, 4143.

Requirements

Have up to a minimum of one year of postdoctoral experience with a demonstrated competence and experience in material science and electrochemistry.

Have demonstrated ability to work independently and lead projects while also collaborating and assisting the group achieve its research goals

Candidates with an ability to interact well with a large interdisciplinary team are encouraged to apply.

Creativity in problem solving and a team spirit

Knowledge of Infrared and X-ray photoelectron spectroscopies, in solution chemical grafting processes, impedance spectroscopy and corrosion assays.

Good communication/written skills

Ability to work towards defined goals in an efficient, safe and scientifically sound manner.

How to apply

Written applications, including a cover letter, CV and contact details of three professional referees should be forwarded to souad.ammarmerah@gmail.com