PhD position

Influence of alloying elements on deformation mechanisms of titanium and zirconium body-centered cubic alloys

Supervisors:

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Research teams:

- Equipe *Chimie-Métallurgie* de l'*Institut des Sciences Chimiques de Rennes* (ISCR) https://iscr.univ-rennes1.fr
- Equipe *Métallurgie Structurale* de l'*Institut de Recherche de Chimie Paris* (IRCP) https://www.ircp.cnrs.fr

Starting date: October 2022

Salary: 1975 € gross/month for the 1st year, and 2300 € gross/month next (ANR funding)

Project description:

Titanium alloys are widely used in aeronautics and in the biomedical field thanks to their excellent mechanical strength / density ratio and their excellent biocompatibility. While alloys mainly containing α phase (hexagonal close-packed) are mostly used, alloys only composed of β phase (body-centered cubic) are more and more used due to their greater potential. However, deformation mechanisms in these later alloys are complex and several points are still not elucidated.

Zirconium alloys are drastically less common but share the same metallurgical properties than titanium alloys. Full β zirconium alloys are thus of great interest for biomedical applications and have been scarcely studied until now. Deformation mechanisms of these alloys are then only sporadically known.

Deformation of these two classes of alloys can be accommodated by one, two or three mechanisms among dislocation slip, twinning and stress-induced martensitic transformation. The goal of this project is to study the activation and characteristics of these three deformation mechanisms as a function of alloying element content and type, as well as temperature. Several Ti-X and Zr-X binary model alloys will be synthetized on purpose during the project. A special focus will be held on understanding the link between macroscopic mechanical properties and elementary mechanisms of deformation that are activated. A multi-scale characterization of the deformation will be implemented during this study:

- Macroscopic mechanical properties will be characterized from tensile tests at temperature ranging from -150 °C to 600 °C.

- Activation of deformation mechanisms will be analyzed at the mesoscopic scale from electron back-scattered diffraction (EBSD) in scanning electron microscope (SEM). *In situ* tensile tests in SEM will also be performed.

- Characteristics of all deformation mechanisms will be investigated from transmission electron microscopy (TEM) observations. *In situ* tensile tests in TEM will also be considered.

The PhD student will progress in the frame of the ANR project ISANAMI and will collaborate with the three partners of the project: ISCR in Rennes, IRCP in Paris and CEMES in Toulouse. The PhD student will mainly be located in ISCR (Rennes) with regular travels to IRCP (Paris) and will be co-supervised by the two laboratories.

Required skills:

Master degree or equivalent degree in Materials Science. The candidate should have astrong interest in experimental sciences. A good level in English is required.

To apply:

Only apply on the website of the *école doctorale*:
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Menu: *UMR CNRS 6226 Institut des Sciences Chimiques Rennes (ISCR)*

Application form must include:
- motivation letter
- detailed CV
- copy of Master degree or equivalent
- transcript of records for the two years of Master
- one or two recommendation letters