

JOB DESCRIPTION

Job Title : Titanium/polymer sheets designed for biomedical applications

Job Summary :

This project deals with the development of **titanium/polymer sandwiches** devoted to biomedical applications with high formability, opening a new field for the application in the human body. Layered hybrid structures/systems composed of biocompatible metal and polymer sheets, either a bi-layered metal (M)/polymer (P), a three-layered M/P/M or vice versa sandwich material, will be elaborated. Compared to existing solutions where bonding is achieved using an epoxy interlayer, the challenge is to get a bonding by a “grafting from” method to guarantee final shaping of the sandwich without delamination. The polymer and the metal thicknesses will be chosen to design the mechanical properties close to the bone’s ones.

The M/P bonding by a “grafting from” method, the control of the interface, the design of their mechanical properties and their shaping behavior will be developed and investigated between the IPCMS- Université de Strasbourg and IMET- Clausthal University of Technology TUC, Germany.

Job Description :

In this project three departments of Institut de Physique et de Chimie des Matériaux de Strasbourg (IPCMS, Director Prof. Stefan Haacke) will be involved: DSI- Département de Surfaces et Interfaces- (Supervisor. Prof. Adele Carradò) is concerned on interface characterizations at nano- and micro-meter scales; DCMI- Département Chimie des Matériaux Inorganiques (Dr. Genevieve Pourroy) and DMO- Département Matériaux Organiques (Dr. Patrick Masson) are centred on the inorganic and organic synthesis respectively, the characterization and the optimization of the different functional materials as well as nano-structured ones.

The main objectives are:

(1) To **design epoxy resin-free P/Ti interfaces**. The epoxy resin is currently used as an adhesive agent in SMs. These resins are not biocompatible and toxic.

A polymerization initiator will be grafted covalently at the Ti surface using a phosphonate anchor. Then, it will be followed by the polymerization of monomers and the formation of polymer chains. Polymethylmethacrylate (PMMA), polybutylmethacrylate (PBMA) or poly2-hydroxyethylmethacrylate (HEMA) will be grown from the initiator using a (controlled) radical polymerization process.

The post-doc candidate will be in charge of this task at IPCMS. Sandwiches will then be prepared at IMET- TUC (Director and supervisor Prof. Heinz Palkowski) by using the research results of IPCMS to prepare the Ti-sheets in an appropriate way and roll bond them to the final sandwiches. If necessary, a mixture of mono- and bi functionalized monomers will be used to cross-link the intermediate layer. **Polymer foils will be inserted between two modified Ti-sheets by roll bonding to create the SMs following the demands for the specific application.**

(2) To fabricate Ti/ P/Ti or P/Ti/ P sandwich sheets of **finally minimum A4 size** varying the ratios of mono-materials thickness, so to design original devices with **tailored mechanical properties** close to the local behaviour of a bone for biomedical applications in craniofacial and mandible surgery.

The challenge of this project is to define a process, suitable for the grafted interface and stabilizing the bonding for the final deformation conditions, so to be strong enough to avoid delamination. **Adhesion tests will be performed by the post-doc candidate at IMET.**

In order to guarantee adequate mechanical performance of the end-product it is foreseen to model and simulate the shaping processes (deep drawing, bending and twisting) for these SMs materials using the Finite Element Method. So, the effect of various process and design parameters on the forming behaviour of SMs such as varied thickness distributions, strain rates and temperatures will be simulated for the aforementioned processes. **The post-doc will support this development.**

Main research field : Chemistry / Physics Other: biomaterial, material science

JOB DETAIL

Type of contract : Temporary
Status : Full-time
Company / Institute : Université de Strasbourg
Country : France
City : Strasbourg
Postal Code : 67000
Street : 4 rue Blaise Pascal

APPLICATION DETAILS (mandatory)

Envisaged job starting date : 01/05/2016
Application deadline : 31/10/2017
Application e-mail : carrado@unistra.fr , genevieve.pourroy@ipcms.unistra.fr