FUNCTIONALIZATION OF TITANIUM SURFACE FOR BIOMEDICAL APPLICATIONS

DIRECTRICE DE THESE : ADELE CARRADO
INSTITUT DE PHYSIQUE ET CHIMIE DES MATERIAUX DE STRASBOURG,
23, RUE DU LŒSS, BP43, 67034 STRASBOURG CEDEX 2
TEL: 03 88 10 7105; E-MAIL: ADELE.CARRADO@IPCMS.UNISTRA.FR

The project deals with the design of new titanium/polymer/titanium hybrid sheets for biomedical applications, typically for craniofacial and mandible surgery: controlling their interface and adjusting their mechanical properties and shaping behaviour. The proposed systems have several advantages compared to the classical materials used for prosthesis. The lightweight multilayer system with graded strength conditions and improved thermal and acoustic properties with respect to titanium alone, and with mechanical properties designable in the range of bones' properties.

During this project *firstly* it will be developed new strategies to design polymer/titanium interfaces free of epoxy resins (not biocompatible), often used as adhesive agents in sandwich sheets; *secondly it will* be employed surface-confined, resin free compatible polymer layers as adhesives for a strong bond between the polymer and the titanium for final shaping the sandwich without delamination. Therefore, creating adhesion between the materials, using the "grafting from" method, is foreseen. This method allows a larger choice of monomer.

A polymerization initiator will be grafted at NaOH modified-Ti surface via a phosphonate anchor[1]. Linear polymer chains of various molar masses, as homopolymers or copolymers types will be grown from the initiator using a controlled radical polymerization process. The monomers used will be of the methacrylic or acrylic series as methyl methacrylate (MMA), *n*-butyl methacrylate (*n*BMA) and methyl acrylate (MA). A mixture of monomers will be used for the synthesis of random copolymers or monomers will be used successively for the synthesis of block copolymers based on PMMA and PBMA (PMMA-co-PBMA) selected in order to decrease the Tg of the copolymer.

The mechanical and shaping properties will be studied and controlled by *the molecular and structural parameters of the polymers* and by modulating the ratio of the layer thicknesses.

The PhD student will work within the international collaborations, established by Prof. A. CARRADO (DSI) and Dr. P MASSON (DMO) and Dr. G. POURROY (DCMI), with colleagues from the universities of Clausthal- Zellerfeld (Germany) and Mainz (Germany).

The candidate is expected to have a very solid background in material science and polymer science, as well as an excellent level of English.

[1] Reggente M, Masson P, Dollinger C, Palkowski H, Zafeiratos S, Jacomine L, Passeri D, Rossi M, Vrana N. E, Pourroy G and Carradò A, A novel alkali-activation of titanium substrates to grow thick and covalently bound PMMA layers, ACS Applied Materials & Interfaces 2018, 10, 5967-5977.