Coatings for Biomedical and Healthcare Applications
Room Palm 3-4 - Session MD3-FrM

Bioactive Surfaces

Moderators: Valentim A.R. Barão, University of Campinas (UNICAMP), Brazil, **Sandra E. Rodil**, Universidad Nacional Autónoma de México

8:20am **MD3-FrM-2 Electrochemical Aspects of Interaction between Surface Engineered Metal Implants and Biological Environment**, ***Aleksey Yerokhin (Aleksey.Yerokhin@manchester.ac.uk)***, University of Manchester, UK **INVITED**

Interfacial redox reactions involving charge transfer between metallic biomaterials and biological environment are of particular interest for development of new generation of biomedical implant devices. Controlling reaction kinetics can help achieving the targeted biological functionality such as osteogenic and biocidal activity, or drug-release ability of surface engineered smart and multifunctional implants; this is also important when minimising corrosion rates to enhance long-term performance of permanent metal implants or controlling degradation behaviour of bioabsorbable implants. Extensive exploratory research at the interface of biomedical and materials engineering often takes advantage of lab-scale electrochemical methods for express assessment of relevant implant properties. However interpreting results of the tests that were originally designed to evaluate aqueous corrosion of metals in engineering applications and are now being adopted to study more complex interactions between implants and biological environment is not straight forward. This talk will revisit electrochemical fundamentals of most common corrosion tests based on potentiodynamic polarisation and frequency response analysis, with a focus on implications for the assessment of implant material degradation in vitro and relevance of obtained characteristics to the implant performance in vivo. Discussions will be provided into effects that composition of simulated biological media, implant surface state and test conditions may have on basic kinetic parameters of anodic and cathodic processes, including exchange current densities, Tafel slopes and limiting current densities, and how these are reflected in polarisation curves. Attention will further be drawn to the multistage nature of the interfacial charge transfer process and correct evaluation of contribution from different stages to the overall corrosion kinetics that inform the strategies for environmental degradation control of biomedical implant materials.

9:00am **MD3-FrM-4 New Approach for Controlling Peri-Implant Infections Integrates Multifunctional Photocatalytic Coating and Photodynamic Therapy – an in Vitro and in Vivo Study**, ***Valentim A. R. Barão (vbarao@unicamp.br)***, *B. Nagay, R. Costa, C. Dini, A. Santos,* University of Campinas (UNICAMP), Brazil*; L. Cintra,* Sao Paulo State University (UNESP), Brazil*; N. da Cruz, L. Faverani,* São Paulo State University (UNESP), Brazil*; J. van den Beucken,* Radboudumc, Netherlands

Although peri-implant infections reduce the longevity of dental implants, there is still no gold-standard therapeutic strategy. Therefore, here we developed a visible light-responsive multifunctional bismuth (Bi)-TiO_2 coating on titanium (Ti) surface to optimize the properties of dental implants and enhance antimicrobial photodynamic therapy (aPDT)-mediated microbial reduction. Bi-TiO_2 experimental coating was synthesized via plasma electrolytic oxidation (PEO). TiO_2 and polished Ti were controls. Topographic, physicochemical, tribological, structural and photocatalytic properties were analyzed. In vitro microbiological assays were performed under different light times (0, 1 and 5 min). In vitro cytocompatibility was evaluated in mesenchymal cells and gingival fibroblasts. The antimicrobial activity and inflammatory response were investigated in vivo (in a subcutaneous tissue of rats). PEO created rough, superhydrophilic and crystalline surfaces, with higher hardness values and tribological performance compared to Ti control ($p<0.05$). Bi-TiO_2 was not cytotoxic and enhanced the microbial reduction mediated by aPTD ($p<0.05$) by presenting photocatalytic activity under visible light. The combination of Bi-TiO_2 and aPDTreduced microbial viability and modulated the inflammatory response in vivo ($p<0.05$). The Bi-TiO_2 coating is a promising strategy for rehabilitation with dental implants as it presents optimized surface properties and enhances microbial reduction and inflammatory modulation mediated by aPDT.

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