Biomaterial Interfaces
Room 321 - Session BI2-TuM

Biomaterials and Nanomaterials Fabrication II

Moderators: Ali Rafati, Medtronic, Inc., **Dr. Christopher So**, Naval Research Laboratory

9:15am **BI2-TuM-6 Tuning Biopolymer Surface Wettability through Plasma Copolymerization***, **Morgan Hawker**, Alexzandria Kubik, Mackenzie Jackson, Kristina Closser,* California State University, Fresno

Plasma, the fourth state of matter, is a partially ionized gaseous mixture and versatile tool for controlling interactions at biointerfaces. Polymers are ubiquitous biomaterials and tailoring how the polymer device interfaces with the biological environment is paramount to controlling its function. For example, promoting favorable cell-surface interactions is needed for tissue engineering devices, whereas preventing bacterial attachment is favorable to prevent infection at the device surface. Plasma-enhanced chemical vapor deposition is a versatile technology to control interactions at the biomaterial/biological environment interface through adding a conformal protective film that encases the polymeric device below. The film is obtained through interfacing a polymer substrate with the plasma (partially ionized gas mixture). Plasma species such as radicals and cations undergo gas-phase reactions, and products from those reactions form the conformal film. Plasma copolymerization is a related strategy that utilizes a mixed feedgas of two or more plasma precursors, whereby conformal coating surface properties can be controlled by simply varying the feedgas composition.

This study reports a previously unexplored combination of plasma precursors – pentane and acrylic acid – to deposit coatings with tunable chemistry and wettability on silk fibroin constructs. Five pentane/acrylic acid feedgas compositions were utilized, ranging from 100%, 75%, 50%, 25%, and 0% pentane by pressure. Plasma deposited coating properties were evaluated through water contact angle goniometry and x-ray photoelectron spectroscopy. Coating static water contact angle values were tunable between >90 degrees to <55 degrees depending on the feedgas composition, which correlated to surface chemical composition. Plasma diagnostics and density functional theory were used to evaluate plasma precursor fragmentation, providing further insights into plasma/surface interactions. This library of plasma-modified silk-based materials can be used to design biomaterial surfaces that are optimally situated for the intended biomedical setting.

9:30am **BI2-TuM-7 Capture of Rare Earth Metals Using Bio-Inspired Polymeric Materials***, **Gillian Kropp**, Kailey Richard, Kenan Fears, Okhil Nag,* U.S. Naval Research Laboratory

Rare earth metals, largely comprised of lanthanides, are essential materials for a wide range of applications, including electronics, imaging and diagnostic technology, and energy systems. However, in nature these metals are found dispersed at low concentrations and mixed with other metals, making them challenging to locate, extract, and chemically isolate. Therefore, developing materials with high selectivity and tuneability is crucial to the separation and extraction of these lanthanides. Peptoids are a class of biomimetic molecules that are expanding the landscape of materials used for therapeutics, diagnostics, and metal chelation. In fact, with the development of new synthetic and automated strategies, peptoid-based materials are highly versatile and tunable. Our goal is to leverage this tuneability to design, synthesize, and characterize materials for selective rare earth metal extraction.

9:45am **BI2-TuM-8 Materials Science / Properties of Transformational Uncoated and Multifunctional/Best Biocompatible Ultrananocrystalline Diamond (Uncd) Coated-Bioactive Bovine Nanohydroxyapatite Scaffolds for Transformational Bone Tissue Engineering***, **Orlando Auciello**,* Texas State University and Original Biomedical Implants*; Angelica Castillo-Paza,* Centro de Investigación y Estudios Avanzados, Mexico*; Leon Bernal-Alvarez,* Universidad Nacional Autónoma de México*; Dorian Cañon-Davila,* Centro de Investigación y Estudios Avanzados, Mexico*; Lerma Chan-Chanc,* Universidad Nacional Autónoma de México, Campus Juriquillalerma@, Mexico*; Rafael Ramírez-Bona,* Centro de Investigación y Estudios Avanzados, Mexico*; Mario Rodriguez-Garciad,* Universidad Nacional Autónoma de México, Campus Juriquilla, Mexico

Abstract

This Talk will be focused on describing materials science and characterization ofphysicochemical properties of hydroxyapatite (HAp) scaffolds and HAp scaffolds coated with a unique transformational best biocompatible (because made of Carbon atoms /element of life in human DNA, cells, molecules) Utrananocrystalline Diamond (UNCD) coating (HAp-UNCD) produced by a patented microwave plasma chemical vapor deposition (MPCVD) and Hot filament Chemical Vapor Deposition (HFCVD) process. The studies involved complementary analytical techniques and biological assays, namely:

1. Scanning Electron Microscopy (SEM) revealed scaffolds' pore structure, critical for bone regeneration / formation and associated EDS chemical analysis showing Ca, P and C atoms.
2. High Resolution Transmission Electron Microscopy (HRTEM) revealed nanoscale structures of HAp and HAp-UNCD scaffolds; and Energy Dispersive Spectroscopy (EDS) analysis confirmed the presence of P on HAp and C atoms in the UNCD coating on HAp scaffolds.
3. X-ray Diffraction (XRD) analysis revealed HAp-UNCD crystalline structure before/after immersion in HBSS, revealing excellent inertness of the UNCD-coated HAp.
4. Raman spectroscopy provided chemical analysis of original HAp and UNCD-coated HAp, before and after immersion in Hanks' Balanced Salt Solution (HBSS).
5. Infrared (IR) analysis revealed carbonate ions on scaffolds' surfaces.
6. X-ray Photoelectron Spectroscopy (XPS) analysis revealed transformational chemical interactions between atoms in HAp scaffolds and in UNCD coated HAp scaffolds.
7. *In vitro* cytotoxicity assays showed NO-cytotoxicity in HAp and HAp-UNCD scaffolds.
8. N_2 adsorption-desorption analysis showed mesoporosity in both scaffolds.
9. Mineral content analysis showed Na / Mg atoms, important elements for bone cells' growth.
10. .
11. Application of Integrated UNCD-coated commercial Ti-alloy dental implants in HAp in maxillary bones demonstrated a new transformational UNCD-coated DIs-maxillary bone integration

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