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
Speaker
Texas State University, Electronic Engineering, San Marcos, TX, USA
CEO. Original Biomedical Implants/ OBI-USA,TX, USA and OBI-México, Hermosillo, México

Angelica M. Castillo-Paz[a], Leon R. Bernal-Alvarez[b], Dorian F. Cañon-Davila[a], Lerma H. Chan-Chan[c], Rafael Ramírez-Bon[a], Mario E. Rodriguez-Garcia[d]

[a] *Centro de Investigación y Estudios Avanzados, IPN, Querétaro, México*
[b] *Centro de Física Aplicada y Tecnología Avanzada, Universidad Nacional Autónoma de México, Campus Juriquilla,Querétaro, México*
[c] *CONAHCYT -Universidad de Sonora, Blvd. Luis Encinas y Rosales, Centro, Hermosillo, C.P. 83000, Sonora, Mexico*
[d] *Departamento de Nanotecnología, Centro de Física Aplicada y Tecnología Avanzada, Universidad Nacional Autónoma de México, Campus Juriquilla, Querétaro, México*

Corresponding Author: Orlando Auciello: orlando50@aol.com

Abstract

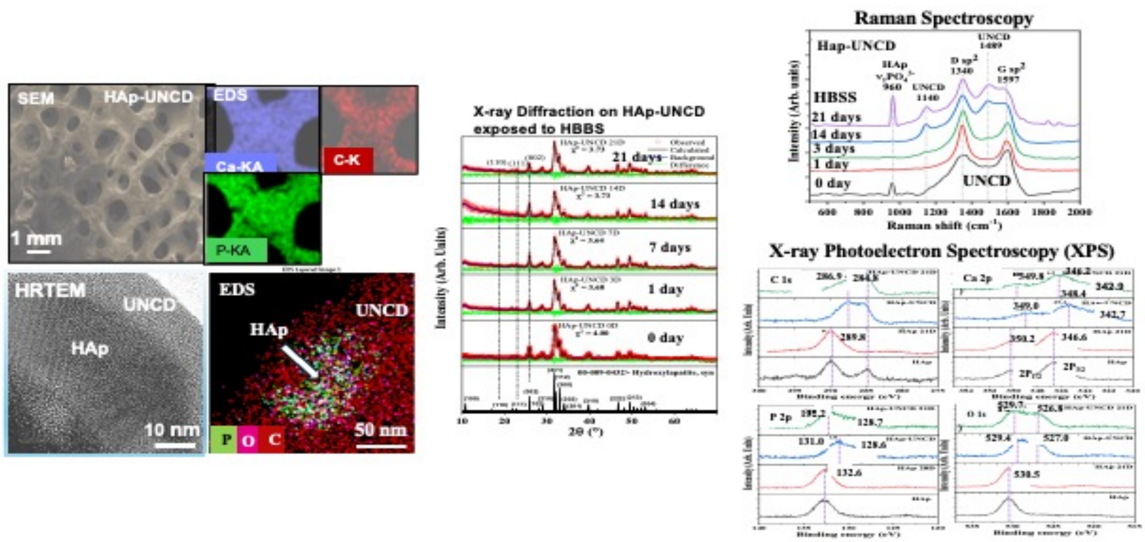
This Talk will be focused on describing materials science and characterization of physicochemical properties of hydroxyapatite (HAp) scaffolds and HAp scaffolds coated with a unique transformational best biocompatible (because made of Carbon atoms /element of life in human DNA, cells, molecules) Utrananocrystalline 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. The UNCD coating increases the HAp' surface roughness, which increase positive bone cellular growth inducing superior bone osseointegration for artificial prostheses.
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

Keywords: Scaffolds, hydroxyapatite, trabecular bone, porosity, UNCD coating. Interfaces

Graphical Abstract



SEM/HRTEM Images EDS Images XRD Analysis XPS Analysis