

## Research Article

# Physicochemical Characterization and *In Vivo* Evaluation of Amorphous and Partially Crystalline Calcium Phosphate Coatings Fabricated on Ti-6Al-4V Implants by the Plasma Spray Method

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**Objective.** To characterize the topographic and chemical properties of 2 bioceramic coated plateau root form implant surfaces and evaluate their histomorphometric differences at 8 and 12 weeks *in vivo*. **Methods.** Plasma sprayed hydroxyapatite (PSHA) and amorphous calcium phosphate (ACP) surfaces were characterized by scanning electron microscopy (SEM), interferometry (IFM), X-ray diffraction (XRD), and Fourier transform infrared spectroscopy (FT-IR). Implants were placed in the radius epiphysis, and the right limb of dogs provided implants that remained for 8 weeks, and the left limb provided implants that remained 12 weeks *in vivo*. Thin sections were prepared for bone-to-implant contact (BIC) and bone-area-fraction occupancy (BAFO) measurements (evaluated by Friedman analysis  $P < 0.05$ ). **Results.** Significantly, higher  $S_a$  ( $P < 0.05$ ) and  $S_b$  ( $P < 0.05$ ) were observed for ACP relative to PSHA. Chemical analysis revealed significantly higher HA, calcium phosphate, and calcium pyrophosphate for the PSHA surface. BIC and BAFO measurements showed no differences between surfaces. Lamellar bone formation in close contact with implant surfaces and within the healing chambers was observed for both groups. **Conclusion.** Given topographical and chemical differences between PSHA and ACP surfaces, bone morphology and histomorphometric evaluated parameters showed that both surfaces were osteoconductive in plateau root form implants.

## 1. Introduction

Most common approaches for dental implant surface modifications involve physically altering the topography or changes in the chemical composition of the surface with the incorporation of inorganic phases [1]. Although topographical changes alone may result in chemistry and physical alterations [2], it has been suggested that improved bone response can be obtained with moderately rough surfaces with  $S_a$

values between 1 and 2  $\mu\text{m}$  [3, 4]. Concerning chemical alterations, implant surface incorporation with hydroxyapatite or other calcium phosphate (CaP) compositions has gained significant attention and is amongst the most investigated implant surface modifications [2]. Regardless of engineering surface alteration method, its final aim is to foster the early bone implant healing events allowing prostheses installation and function at earlier time frames than initially proposed [5–7].

# Characterization And Performance Of Calcium Phosphate Coatings For Implants Special Technical Publications No 1196

**Jiyuan Zhang**



## **Characterization And Performance Of Calcium Phosphate Coatings For Implants Special Technical Publications No 1196:**

**Characterization and Performance of Calcium Phosphate Coatings for Implants**, 1911 Books in Print, 1994  
*Subject Guide to Books in Print*, 1991 **Medical and Health Care Books and Serials in Print**, 1997 **Directory of Published Proceedings**, 1995 **Books in Print Supplement**, 1994 **Monthly New Ceramics**, 1993 **Thin Calcium Phosphate Coatings for Medical Implants** Betty León, John Jansen, 2009-06-29 Calcium phosphate coatings 50 mm thick especially those made with hydroxyapatite HA produced by the plasma spraying process have been successfully used on orthopedic and dental implants to improve fixation of these implants in bone Thin calcium phosphate coatings 10mm thick formed by various techniques other than plasma spraying may be the successor of the current thick plasma sprayed coatings because of their improved properties Like plasma sprayed HA coatings these alternative calcium phosphate thin coatings are capable of enabling bone formation on their surfaces and forming a bond with the newly formed bone In addition the thin calcium phosphate coatings have shown better adhesion to substrates and are more stable in the biological environment because they have more uniform structure and composition than plasma sprayed HA coatings Moreover some of these thin calcium phosphate coatings can be formed on all kinds of substrates including polymers and on the entire surfaces of complex geometries such as porous surfaces **Calcium Phosphate Coatings for Bio-implant Applications** Narendra B. Dahotre, 2009 **Characterization of Plasma Sprayed Calcium Phosphate Coatings on Ti-(6Al-4V) for Biomedical Applications** Eunsung Park, 1998 *Survey of Fabrication Techniques and Characterization of a Calcium Phosphate Implant Material* Kenneth John Hamilton, 1980 Ion-Substituted Calcium Phosphates Coatings Gabriela Graziani, Enrico Sassoni, 2021-01-28 Coatings based on hydroxyapatite and calcium phosphates have a significant relevance in several research fields such as biomaterials cultural heritage and water treatment due to their characteristic properties Hydroxyapatite can easily accommodate foreign ions which can either be incorporated into the lattice thanks to its specific lattice characteristics or be adsorbed onto its surface All these substitutions significantly alter the morphology lattice parameters and crystallinity of hydroxyapatite so they influence its main properties These ion substitutions can be sought or can derive from substrate contaminations which is an important aspect to be evaluated Finally this capability can be used to obtain hydroxyapatites with specific properties such as antibacterial characteristics among others For these reasons the aim of this Special Issue is to document current advances in the field of ion substituted hydroxyapatites and highlight possible future perspectives regarding their use Contributions in the form of original articles and review articles are presented covering different areas of application **Calcium Phosphate Nanocoatings for Bone Regeneration** Andy H. Choi, Besim Ben-Nissan, 2023-09-11 This book provides in depth assessment on the latest clinical advances in multifunctional calcium phosphate nanocoatings and its influence on bone regeneration and early healing following implantation A greater

emphasis will be placed on the use of nanocomposite coatings to deliver biological materials such as mesenchymal stem cells growth factors bone morphogenetic and extracellular matrix proteins and pharmaceuticals such as simvastatin to improve and promote bone growth as well as reducing the timeframe needed for implant integration in both healthy and osteoporotic patients The content of the book caters to clinical practitioners and researchers working in the field of biomaterials for bone regeneration

**Calcium Phosphate Coatings for Fixation of Bone Implants**, 2000      **Calcium Phosphate Coatings Based on Mineralization in Natural Hard Tissues** Hai-Bo Wen, 1998-01-01      Implants for Surgery - Calcium Phosphate Bioceramics - Characterization of Hardening Bone Paste Materials ISO/DIS 18531, 2015      **Calcium Phosphate** Robert B. Heimann, 2012

Calcium phosphates are key materials to sustain life on Earth as constituent of the gravity defying bony skeletons of all vertebrates as well as the dentine and enamel materials of teeth This book contains accounts on the historical development of the scientific knowledge gained on calcium orthophosphates the latest information on the structure of carbonate bearing hydroxyapatite the role played by small amounts of molecular water residing in synthetic hydroxyapatite and bone mineral as well as the nature of oxyhydroxyapatite and oxyapatite as intermediates during dehydroxylation of hydroxyapatite pertinent information to unravel the complex processes relevant for plasma sprayed calcium phosphate coatings on endoprosthetic implants This book is recommended to industrial and academic professionals in the fields of medical technology orthopedy dentistry biology materials science chemistry environmental engineering and mineralogy

**Characterization of Modified Calcium Phosphate Dental Implant Cement** Saied Al-Zahrani, 1998      Sprayed and Sputtered Calcium Phosphate Coatings for Medical Implants Johannes Gerardus Cornelis Wolke, 1997\* Zsfassung in niederl nd Sprache      *Calcium Phosphate Coatings for Fixation of Bone Implants* Søren Overgaard, 2000

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