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Biocompatibility, bioactivity and antibacterial behavior of zirconium-containing bioactive glass for dental implant coatings

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Edentulism, or the loss of teeth, presents a substantial issue that affects many individuals. Removable prostheses, which are commonly used to address this problem, can often result in feelings of discomfort and a lack of confidence. These negative consequences can be further compounded by social stigmas, ultimately leading to a reduced quality of life for patients. As a result, implantology has become a vital component in the field of oral rehabilitation, offering patients the opportunity to restore both their aesthetic appearance and masticatory function. Despite advances in implant technology, certain problems may still arise that hinder osseointegration and result in the rejection of the implant. Using bioglass as a coating material can promote tissue integration. In addition, 45S5 bioglass® has been found to possess antimicrobial properties against various bacteria due to the release of sodium and calcium ions that can disrupt the cell membrane, preventing the growth of microorganisms. The main objective of this work is to address the challenges that affect the dental implant sector by developing a biomaterial for implant coating based on 45S5 Bioglass® modified by zirconium insertion. Various methods were used to analyze the materials including thermal (DTA), structural (XRD, FTIR), morphological (SEM) and biological (cytotoxicity, antibacterial activity and bioactivity). It was observed that the introduction of zirconium in the bioglass network at a concentration higher than 2 mol% promotes the formation of crystalline phases. All the prepared bioglasses exhibited an antibacterial effect against Gram-positive and Gram-negative bacteria and did not show cytotoxicity for the Saos-2 cell line up to 25 mg/mL of extract concentration. Moreover, the result of the bioactivity test in SBF showed that, within 24 hours, a CaP-rich layer started to form on the surface of all the samples.

Biography

Imen Hammami is a Physics Engineering PhD researcher at Aveiro University under the supervision of Prof. M.P.F. Graca. She has a master's degree in Condensed Matter. She has been dedicating to the synthesis and characterization of glass, glass ceramics and polymer composites. She is currently working as a Research Fellow at i3N-Aveiro, within the P2020 project, called ORAiDEA, "Development of Multifunctional Dental Implants", funded by the European Regional Development Fund (ERDF) through the Competitiveness and Internationalization Operational Program (POCI). In this position, she is expanding her knowledge on the development of biomaterials capable of supporting the osteogenic differentiation of Mesenchymal Stromal (Stem) Cells (MSCs) with potential tissue engineering applications and their full characterization at a physical, chemical and biological level to the development of essential coatings for the implants.

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