

Advancements in bone regeneration - the impact of manganese doping on hydroxyapatite bioceramics

Prof. Bożena Tylińczak, Cracow University of Technology, Krakow, Poland

Magdalena Bańkosz, MSc, Cracow University of Technology, Krakow, Poland

Karina Piętaś, MSc, Cracow University of Technology, Krakow, Poland

Dagmara Słota, MSc, Cracow University of Technology, Krakow, Poland

Prof. Agnieszka Sobczak-Kupiec, Cracow University of Technology, Krakow, Poland

Abstract

Statement of the Problem: Incorporating manganese (Mn) into the structure of hydroxyapatite (HAp), a principal mineral in bone tissue, has been an innovative approach in biomaterial engineering aimed at enhancing the functionality and potential applications of calcium phosphate bioceramics. The integration of Mn into HAp has been explored for its dual benefits in reinforcing the mechanical strength and promoting osteoconductive properties of the bioceramics, thereby offering a promising pathway for advancements in bone regeneration technologies. The process of doping HAp with Mn not only impacts the material's structural integrity but also optimizes its biocompatibility, making it a suitable candidate for regenerative medicine and implantology.

Through meticulous analysis employing techniques like Scanning Electron Microscopy (SEM) and X-Ray Diffraction (XRD), the study reveals that Mn doping induces notable modifications in the microstructure of HAp, including alterations in grain size and morphology. These changes are critical in improving the mechanical attributes of the bioceramics, as well as their interaction with biological environments, thus facilitating enhanced bone tissue integration and growth. Furthermore, the study highlights the potential of Mn-modified HAp in offering antibacterial properties, an essential factor for the prevention of post-surgical infections in implant applications.

Conclusion & Significance: The findings of this research underscore the multifaceted role of Mn in advancing the properties of calcium phosphate bioceramics. By delving into the complex interactions at the molecular level, this study contributes to a deeper understanding of the mechanisms through which Mn

enhances the efficacy of HAp-based materials. The promising outcomes of Mn incorporation into HAp pave the way for the development of next-generation biomaterials that could revolutionize the field of bone tissue engineering and implant design, aligning with the overarching goal of improving patient outcomes in bone repair and regeneration.

Additional information

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Recent publications

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Photograph



Biography

Associate Professor Bożena Tylińczak of Krakow University of Technology is leading research in the field of biomaterials, with more than 15 patents and 100 scientific publications. She specializes in hydrogel drug delivery systems and advanced wound dressings, and is a leader in improving therapeutic outcomes and promoting effective wound healing. Her work extends to ceramic composites and hydroxyapatite biomaterials, key in restoring bone properties in orthopedic and dental applications. Her outstanding contributions to the development of breakthrough biomedical materials have brought her more than 200 national and international awards, highlighting her impact in the field. In 2016 she was honored by the World Intellectual Property Organization (WIPO) with the "Medal for Inventors OMPI" for the inventions developed during her interdisciplinary research in the area of material engineering, nanotechnology and biotechnology

Email: bozena.tylińczak@pk.edu.pl