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Magnetic Calcium Phosphate-based Scaffolds for Multi-Therapy Innovation: Unlocking Potential for Bone Tissue Engineering

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Project:

Abstract

Already widely studied in the literature, calcium phosphate (CaP)-based bioceramics present themselves as the prime materials for bone regeneration purposes, mainly due to their chemical similarity with inorganic part of the bone. However, native hard tissue is constituted by many different trace elements as magnesium, zinc, strontium and iron, essential for a healthy and functional metabolic activity of the bone. In order to bridge this compositional mismatch of synthetic CaP-based bone substitutes with native bone, multi-doping calcium phosphates with those ions have gathered great attention in the last decades. In the particular case, doping CaP with iron ions emerges as an approach with high potential in CaP-based materials since their presence can confer them enhanced mechanical properties, as well as intrinsic magnetic properties. In addition, by applying an external magnetic field (EMF), it also enhances their osteogenic behaviour (static EMF) and can act as cancer treatment platforms by magnetic hyperthermia (alternating EMF).

On account of the significant impact of this topic, this research focused on developing self-setting iron doped CaP (FeCaP)-based inks, formulated for the fabrication of 3D scaffolds with intrinsic magnetic properties, using robocasting technology. Through the optimization of the inks' formulation for suitable printing behavior, it was possible to obtain scaffolds characterized by their precise geometry, controlled pore sizes and good mechanical properties. Likewise, magnetic characterization of the scaffolds showed superparamagnetic-like behavior, showcasing promising features for bone tissue engineering applications involving the application of an EMF.