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Entitled

Fabrication of Chemically-functionalized 3D-printed Porous Scaffolds for Biomedical Applications

by

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Abstract

Hard tissues, such as bone and teeth, are natural composites of collagen nanofibers that are reinforced by inorganic calcium phosphate nanocrystallites, in the form of nanocomposites. The interlocking between these components in hard tissues explains their unique characteristics. Bone is mainly classified into two major types; compact and cancellous depending on the extent of porosity. Fractures in compact bone can be treated using bone fixation implants, such as rods, screws and plates, or can be totally replaced by bone implants if complete substitution is required. Cancellous bone, on the other hand, is highly porous and its substitution with synthetic biomaterials is a challenge. The current study investigates the use of a 3D printing technology to fabricate 3D porous scaffolds that can be used as substitutes of fractured cancellous bone. Three types of polymers have been investigated because of their classification as bioactive (poly(ethyelen terephthalate); PET), biodegradable (poly(lactic acid); PLA) and bioinert (Acrylonitrile-butadiene-styrene terepolymer); ABS). All polymers were 3D printed into highly porous scaffolds that were further chemically-functionalized to enhance their surface properties, hence improve their potential application as bone implants. Both as-printed and chemically functionalized porous scaffolds were characterized for their structure and morphology. Moreover, chemically-treated PET and PLA scaffolds were investigated for their preliminary in vitro performance in a simulated body fluid (SBF) medium, while chemically conditioned ABS scaffolds were used as platform to grow a biodegradable metal-organic framework (HKUST-1) onto their surfaces. Preliminary results of the current study showed the potential of the chemically functionalized porous scaffolds to be used as implants for the partial and total replacement of defective porous bone.

Keywords: Bone implants, 3D printing, porous scaffolds, biomimetic, metal-organic framework