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Authors: Gil Costa Machado, Esther García-Tuñón, Robert V. Bell, Mauro Alini, Eduardo Saiz, Marianna Peroglio

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Calcium phosphate substrates with emulsion-derived roughness: processing, characterisation and interaction with human mesenchymal stem cells

Gil Costa Machado[1], Esther García-Tuñón[2,3], Robert V. Bell[4], Mauro Alini[5], Eduardo Saiz[1], Marianna Peroglio[5]

[1]Department of Materials, Imperial College London, South Kensington, London, SW7 2BP, UK
[2]Materials Innovation Factory, University of Liverpool
[3]School of Engineering, University of Liverpool
[4]Department of Chemistry, University of Warwick, Coventry, CV4 7AL, UK
[5]AO Research Institute Davos, Switzerland

Corresponding author
g.machado@imperial.ac.uk (Gil Costa Machado)
New e-mail: g.machado@manchester.ac.uk

ABSTRACT

Calcium phosphates (CaP) have been the subject of several studies that often lack a systematic approach to understanding how their properties affect biological response. CaP particles functionalised with a pH-responsive polymer (BCS) were used to prepare microporous substrates (porosity between 70-75% and pore sizes of 5-20μm) through the aggregation of oil-in-water emulsions by controlling solid loading, emulsification energy, pH, drying and sintering conditions. The combined effect of surface roughness (roughness amplitude, R_a between 0.9-1.7μm) and chemistry (varying Hydroxyapatite/β-Tricalcium phosphate ratio) on human mesenchymal stem cells was evaluated. HA substrates stimulated higher cell adhesion and proliferation (especially with lower R_a), but cell area increased with β-TCP content. The effect of surface roughness depended of chemistry: HA promoted higher mineralising activity when R_a~1.5μm, whereas β-TCP substrates stimulated a more osteogenic profile when R_a~1.7μm. A novel templating method to fabricate microporous CaP substrates was developed, opening possibilities for bone substitutes with controlled features.

Keywords: Calcium phosphates; Emulsions; Microporosity; Surface roughness; human mesenchymal stem cells

1. INTRODUCTION

Millions of people suffer bone injuries every year, either accidental or disease related, that call for the use of bone substitutes with controlled properties to promote cell migration, adhesion, differentiation and ultimately formation of new bone. All this, while they degrade