Title: Poly(1,8-octanediol citrate)/bioactive glass composite with improved mechanical performance and bioactivity for bone regeneration

Authors: Hui-Hui Ren, Hui-Yu Zhao, Yang Cui, Xiang Ao, Ai-Ling Li, Zhong-Min Zhang, Dong Qiu

PII: S1001-8417(17)30259-0
DOI: http://dx.doi.org/doi:10.1016/j.cclet.2017.07.014
Reference: CCLET 4132

To appear in: *Chinese Chemical Letters*

Received date: 27-4-2017
Revised date: 9-6-2017
Accepted date: 12-7-2017

Please cite this article as: Hui-Hui Ren, Hui-Yu Zhao, Yang Cui, Xiang Ao, Ai-Ling Li, Zhong-Min Zhang, Dong Qiu, Poly(1,8-octanediol citrate)/bioactive glass composite with improved mechanical performance and bioactivity for bone regeneration, Chinese Chemical Lettershttp://dx.doi.org/10.1016/j.cclet.2017.07.014

Communication

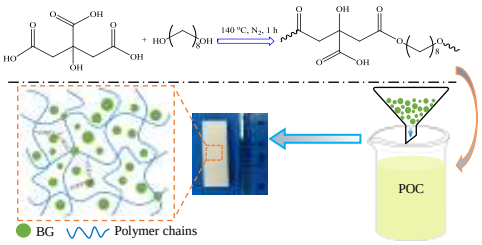
Poly(1,8-octanediol citrate)/bioactive glass composite with improved mechanical performance and bioactivity for bone regeneration

Hui-Hui Ren[a,b,1], Hui-Yu Zhao[c,1], Yang Cui[a,b], Xiang Ao[c], Ai-Ling Li[a], Zhong-Min Zhang[c,*], Dong Qiu[a,b,*]

[a] *Beijing National Laboratory for Molecular Sciences, State Key Laboratory of Polymer Physics and Chemistry, CAS Research/Education Center for Excellence in Molecular Sciences, Institute of Chemistry, Chinese Academy of Sciences, Beijing 100190, China*
[b] *University of Chinese Academy of Sciences, Beijing 100190, China*
[c] *Department of Orthopedics, The Third Affiliated Hospital of Southern Medical University, Guangzhou 510665, Guangdong, China*

∗ Corresponding authors.
E-mail address: nfzzm@163.com (Z.-M. Zhang), dqiu@iccas.ac.cn (D. Qiu).
[1] These authors contributed equally to this work.

Graphical abstract



A series of POC/bioactive glasses (BG) composites were developed using a phytic acid-derived bioactive glass. These composites exhibited improved mechanical performance and excellent biological properties, which make them promising for potential application in bone regeneration.

Abstract

Poly(1,8-octanediol-co-citrate) (POC) represents a new promising biocompatible and biodegradable polyester that has been extensively investigated for soft tissue engineering. However, the poor mechanical performance and poor bioactivity limit its application in bone regeneration. In this study, a series of POC/bioactive glasses (BG) composites were developed using 45S5 Bioglass® and a phytic acid-derived bioactive glass (referred as PSC). The results indicated that calcium in BG could enhance the crosslinking of the POC/BG composites by forming calcium dicarboxylate bridges and thus improve their mechanical performances. When PSC were used, the composites exhibited significantly better mechanical properties compared to composites with 45S5 Bioglass®. For example, by incorporating 70 wt% PSC, the compressive strength of POC/PSC composites could be improved to approximately 50 MPa and modulus 1.3 ± 0.1 GPa. Furthermore, all these POC/PSC composites showed good *in vitro* bioactivity and cellular biocompatibility. Histology results in femoral condyle defects of Sprague-Dawley rats indicated that the POC/PSC samples integrated well with surrounding tissues and stimulated bone regeneration. The improved mechanical properties and bioactivity of POC/PSC composites make them promising for potential application in bone regeneration.

Keywords:Bioactive glasses Poly(1,8-octanediol-co-citrate) Composites Mechanical properties Bioactivity

Bone defects and damage caused by trauma, tumor or diseases are one of the most troubling problems in human health. Bone repair materials, including autografts, allografts, xenografts and artificial biomaterials are widely used in clinic [1-3]. However, autografts, allografts and xenografts have some specific drawbacks such as limited availability, potential risks of transmitting disease and inducing immune responses, *etc.* [1,4]. For these reasons, artificial bone substitutes are in high demand.

Poly(1,8-octanediol-co-citrate) (POC) represents a new promising biocompatible and biodegradable polyester developed recently for tissue engineering. This elastomer is easy to synthesize through a simple, catalyst-free polycondensation reaction with non-toxic monomers and its mechanical and degradation properties can be tuned by controlling the synthesis conditions [5]. Furthermore, the pendant carboxyl and hydroxyl groups make it possible to design novel POC-based materials with antimicrobial, fluorescent, adhesive