Journal of Biomaterials Science, Polymer Edition ›

Volume 25, 2014 - Issue 16

Articles

Solvent-free polymer/bioceramic scaffolds for bone tissue engineering: fabrication, analysis, and cell growth

Joshua Minton, Cara Janney, Rosa Akbarzadeh, Carlie Focke, Aswati Subramanian, Tyler Smith, ...show all

Pages 1856-1874 | Received 21 Feb 2014, Accepted 06 Aug 2014, Published online: 02 Sep 2014

Cite this article https://doi.org/10.1080/09205063.2014.953016 Check for updates

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Abstract

This study examines the potential use of porous polycaprolactone (PCL) and polycaprolocatone/hydroxyapatite (PCL/HA) scaffolds fabricated through melt molding and porogen leaching for bone tissue engineering. While eliminating organic solvents is desirable, the process steps proposed in this study for uniformly dispersing HA particles (~5 µm in size) within the scaffold can also contribute to homogeneous properties for these porous composites. Poly(ethylene oxide) (PEO) was chosen as a porogen due to its similar density and melting point as PCL. Pore size of the scaffold was controlled by limiting the size of PCL and PEO particles used in fabrication. The percent of HA in the fabricated scaffolds was quantified by thermogravimetric analysis (TGA). Mechanical

testing was used to compare the modulus of the scaffolds to that of bone, and the pore size distribution was examined with microcomputed tomography (μCT). Scanning electron microscopy (SEM) was used to examine the effect on scaffold morphology caused by the addition of HA particles. Both μCT and SEM results showed that HA could be incorporated into PCL scaffolds without negatively affecting scaffold morphology or pore formation. Energy-dispersive X-ray spectroscopy (EDS) and elemental mapping demonstrated a uniform distribution of HA within PCL/HA scaffolds. Murine calvaria-derived MC3T3-E1 cells were used to determine whether cells could attach on scaffolds and grow for up to 21 days. SEM images revealed an increase in cell attachment with the incorporation of HA into the scaffolds. Similarly, DNA content analysis showed a higher cell adhesion to PCL/HA scaffolds.

Keywords:

bone | polycaprolactone | hydroxyapatite | scaffolds | tissue engineering | cell culture

Acknowledgments

This work was partially supported by the Ohio Board of Regents and the Ohio Third Frontier Program grant entitled: ‘Ohio Research Scholars in Layered Sensing’. The authors wish to thank Dr. Gilbert Pacey for providing support with the TGA measurements and Dr. Roberto Fajardo for the μCT analysis. The authors also acknowledge the technical assistance of Dr. Byran Smucker, Dr. Richard Edelmann, Matt Duley, Doug Hart, Bill Lack, Barry Landrum, Lynn Johnson, Jayson Alexander, Kevin Harris, Ryan Walczak, and the administrative assistance of Laurie Guest.