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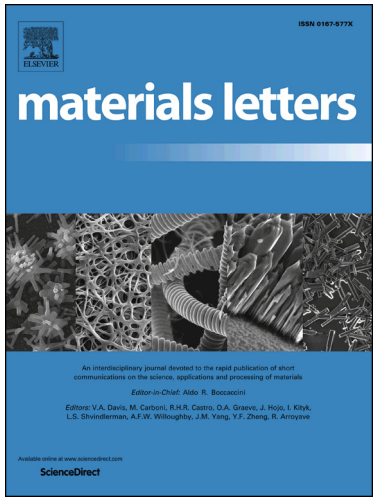

Dual Pore Network Polymer Foams for Biomedical Applications via Combined Solid State Foaming and Additive Manufacturing

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Abstract

Dual pore network polymer foams are categorized as foams having two interconnected pore networks of varying sizes. Potential applications of these foams are in the biomedical field for artificial organ development and high throughput drug testing. In this study, a cost effective and scalable processing technique for fabrication of dual pore network polymer foams via solid state foaming of additively manufactured templates is presented. Initially, a polymer template with either circular or hexagonal features is additively manufactured with the spacing between the features forming the first porous network. The second porous network is obtained by subjecting the additively manufactured template to solid state foaming. The resulting foams have porosity in excess of 80% with the pore sizes in the larger and smaller pore network on the order of 200 µm and 50 µm respectively.

Keywords: Biomaterials, Polymers, Porous Materials, Solid State Foaming.

1. Introduction

In the recent past, there has been a great increase in the demand for fabrication of artificial tissue scaffolds as failure and loss of human organs is one of the costliest problems in healthcare [1]. The major requirement for a tissue scaffold used in development of artificial organs and drug testing is high porosity combined with a dual network of interconnected pores [2,3]. A dual pore network is required to provide separate pathways for growth of tissue cells and for delivery of nutrients or waste extraction respectively [4,5]. Currently, scaffolds have been fabricated utilizing techniques like gel casting [6], solvent casting [7], electrospinning [8], and solid free form fabrication [9,10] from a variety of bio-compatible materials such as Polylactide (PLA) [11,12], Polyglycolide (PGA) [13] and Polycaprolactone (PCL) [14]. However, these