3D Printed Silicone–Hydrogel Scaffold with Enhanced Physicochemical Properties - DTU Orbit (08/11/2017)

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Scaffolds with multiple functionalities have attracted widespread attention in the field of tissue engineering due to their ability to control cell behavior through various cues, including mechanical, chemical, and electrical. Fabrication of such scaffolds from clinically approved materials is currently a huge challenge. The goal of this work was to fabricate a tissue engineering scaffold from clinically approved materials with the capability of delivering biomolecules and direct cell fate. We have used a simple 3D printing approach, that combines polymer casting with supercritical fluid technology to produce 3D interpenetrating polymer network (IPN) scaffold of silicone-poly(2-hydroxyethyl methacrylate)-co-poly(ethylene glycol) methyl ether acrylate (pHEMA-co-PEGMEA). The pHEMA-co-PEGMEA IPN materials were employed to support growth of human mesenchymal stem cells (hMSC), resulting in high cell viability and metabolic activity over a 3 weeks period. In addition, the IPN scaffolds support 3D tissue formation inside the porous scaffold with well spread cell morphology on the surface of the scaffold. As a proof of concept, sustained doxycycline (DOX) release from pHEMA-co-PEGMEA IPN was demonstrated and the biological activity of released drug from IPN was confirmed using a DOX regulated green fluorescent reporter (GFP) gene expression assay with HeLa cells. Given its unique mechanical and drug releasing characteristics, IPN scaffolds may be used for directing stem cell differentiation by releasing various chemicals from its hydrogel network.

General information

State: Published
Organisations: Department of Micro- and Nanotechnology, BioLabChip, Fluidic Array Systems and Technology, Colloids and Biological Interfaces, Department of Chemical and Biochemical Engineering, The Danish Polymer Centre, Bioanalytics, Biomodics ApS
Authors: Mohanty, S. (Intern), Alm, M. (Ekstern), Hemmingsen, M. (Intern), Dolatshahi-Pirouz, A. (Intern), Trifol Guzman, J. (Intern), Thomsen, P. (Ekstern), Dufva, M. (Intern), Wolff, A. (Intern), Emnéus, J. (Intern)
Number of pages: 9
Pages: 1321-1329
Publication date: 2016
Main Research Area: Technical/natural sciences

Publication information

Journal: Biomacromolecules
Volume: 17
Issue number: 4
ISSN (Print): 1525-7797
Ratings:
BFI (2017): BFI-level 2
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 5.74 SJR 1.973 SNIP 1.334
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 2.134 SNIP 1.449 CiteScore 6.05
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 2.207 SNIP 1.652 CiteScore 6.38
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 2.085 SNIP 1.617 CiteScore 6.07
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 2.317 SNIP 1.677 CiteScore 5.72
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 2.213 SNIP 1.777 CiteScore 5.74
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes

BFI (2010): BFI-level 1
Scopus rating (2010): SJR 2.333 SNIP 1.66
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 2.288 SNIP 1.6
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 2.228 SNIP 1.487
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 2.173 SNIP 1.528
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.854 SNIP 1.492
Scopus rating (2005): SJR 1.643 SNIP 1.467
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 1.454 SNIP 1.34
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 1.17 SNIP 1.187
Scopus rating (2002): SJR 1.033 SNIP 1.148
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 0.787 SNIP 0.804
Web of Science (2000): Indexed yes
Original language: English
DOIs:
10.1021/acs.biomac.5b01722
Publication: Research - peer-review › Journal article – Annual report year: 2016