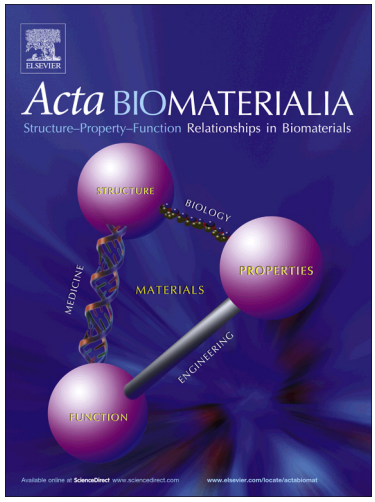

Full length article

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PII: S1742-7061(18)30468-9
DOI: https://doi.org/10.1016/j.actbio.2018.08.010
Reference: ACTBIO 5614

To appear in: *Acta Biomaterialia*

Received Date: 1 March 2018
Revised Date: 5 August 2018
Accepted Date: 7 August 2018

Please cite this article as: Li, Z., Tuffin, J., Lei, I.M., Ruggeri, F.S., Lewis, N.S., Gill, E.L., Savin, T., Huleihel, L., Badylak, S.F., Knowles, T., Satchell, S.C., Welsh, G.I., Saleem, M.A., Yan Shery Huang, Y., Solution Fibre Spinning Technique for the Fabrication of Tuneable Decellularised Matrix-Laden Fibres and Fibrous Micromembranes, *Acta Biomaterialia* (2018), doi: https://doi.org/10.1016/j.actbio.2018.08.010

Solution Fibre Spinning Technique for the Fabrication of Tuneable Decellularised Matrix-Laden Fibres and Fibrous Micromembranes

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Abstract

Recreating tissue-specific microenvironments of the extracellular matrix (ECM) *in vitro* is of broad interest for the fields of tissue engineering and organ-on-a-chip. Here, we present biofunctional ECM protein fibres and suspended membranes, with tuneable biochemical, mechanical and topographical properties. This soft and entirely biologic membrane scaffold, formed by micro-nano-fibres using low voltage electrospinning, displays three unique characteristics for potential cell culture applications: high-content of key ECM proteins, single-layered mesh membrane, and flexibility for *in situ* integration into a range of device setups. Extracellular matrix (ECM) powder derived from urinary bladder, was used to fabricate the ECM-laden fibres and membranes. The highest ECM concentration in the dry protein fibre was 50 wt%, with the rest consisting of gelatin. Key ECM proteins, including collagen IV, laminin, and fibronectin, were shown to be preserved post the biofabrication process. The single fibre tensile Young's modulus can be tuned for over two orders of magnitude between ~ 600 kPa to 50 MPa depending on the ECM content. Combining the fibre mesh printing with 3D printed or microfabricated structures, culture devices were constructed for endothelial layer formation, and a trans-membrane co-culture formed by glomerular cell types of podocytes and glomerular endothelial cells, demonstrating feasibility of the membrane culture. Our cell culture observation points to the importance of membrane mechanical property and re-modelling ability as a factor for soft membrane-based cell cultures. The ECM-laden fibres and membranes presented here would see potential applications in *in vitro* assays, and tailoring structure and biological functions of tissue engineering scaffolds.

Keywords: extracellular matrix; electrospinning; fibre; membrane stiffness; in vitro models.