Sheffield Hallam University

Bladder tissue engineering using auxetic materials

How to apply

Applicants are requested to email a postgraduate application form (including a 1500 word proposal in section 9) to HWB-DoctoralAdmin@shu.ac.uk by 12 noon on Friday 24 February 2017.

Where English is not your first language, you must show evidence of English language ability to the following minimum level of proficiency: an overall IELTS score of 7 or above, with at least 6.5 in each component or an accepted equivalent. Please note that your test score must be current, i.e. within the last two years.

Please view our eligibility criteria before submitting an application.

Selection process

Successful applicants will be required to attend an interview where you will be asked to talk through your research proposal.

Project details

Director of Studies: Dr Christine Le Maitre; second supervisors: Prof. Andrew Alderson & Dr. Nikki Jordan Mahy

Biomolecular Sciences Research Centre

External partner: Pioneer Healthcare Ltd

Project description:

The global tissue engineering market is worth ~$2.59 to $11 billion (2012-2014), with significant growth forecast to reach $27 billion by 2018 and $73 billion by 2025) [1,2]. The major market focus is related to orthopaedics, skin, oncology, cardiovascular, dental, neurology and urinary systems.

Urinary incontinence and bladder defects affect >200 million people worldwide, costing >US$16 billion in the USA in 2001, of which ~75% relates to surgical treatment [3]. Tissue engineering scaffolds for regenerative therapies of the bladder are required to match target tissue attributes, withstand a variety of loading conditions, support and stimulate cell growth, and maintain the bladders' normal anatomy and physiology.

Natural biological tissues are known to display auxetic characteristics - the material becomes thicker, rather than thinner, when stretched, corresponding to negative Poisson's ratio. These properties have been demonstrated in skin [4,5], artery [6], tendon [7], embryonic tissues [8], and, possibly cancellous bone [9]. Natural biomaterials can also display gradient and/or anisotropic structure and properties. Mechanical stimulation of the scaffold promotes cell proliferation and a recent study indicated enhanced proliferation may occur in an auxetic scaffolds [10]. Auxetic porous materials facilitate mass transport [11] and, therefore, there is potential for optimal flow or delivery of nutrients, metabolic wastes and therapeutic agents. For these reasons, the development of porous auxetic materials promises to deliver improved next-generation tissue engineering scaffolds.

The overarching aim of this interdisciplinary PhD project is to develop a range of 'auxetic' porous scaffolds for eventual tissue engineering of the bladder; which mimic mechanical properties of the soft tissues; promote migration, adhesion and differentiation of cells and enable delivery of bioactive components.

The project will determine the mechanical properties of natural bladder tissue and utilise this knowledge to develop a range of auxetic scaffolds for investigation in vitro. Bladder cells will be cultured on the scaffolds and the behaviour of the cells on the scaffolds will be determined using a variety of biochemical, histological, immunohistological, molecular biology, scanning electron microscopy and biomechanical analysis to determine the cell behaviour and interaction with the auxetic scaffold.

Successful applicants could receive the additional benefits of involvement in the University Alliance Doctoral Training Alliance in Applied Biosciences for Health

For further information, please contact Dr Christine Le Maitre c.lemaitre@shu.ac.uk

References:

[1] http://www.transparencymarketresearch.com/regenerative-medicines-market.html

[2] http://www.prnewswire.com/news-releases/tissue-engineering-the-combination-of-cells--engineering---a-global-market-overview-139680153.html

[3] D. M. Kollhoff et al, Regen. Med. (2011) 6(6), 757–765.

[4] D. R. Veronda, R. A. Westmann, J. Biomechanics (1970) 3, 111.

[5] C. Lees et al, Bio-Medical Materials and Engineering (1991) 1, 19.

[6] L. H. Timmins et al, Am. J. Physiol. Heart Circ. Physiol. (2010) 298, H1537.

[7] R. Gatt et al, Acta Biomaterialia (2015) 24, 201.

[8] X. Chena, W. Brodland, Journal of the Mechanical Behaviour of Biomedical Materials (2009) 2, 494.

[9] J. L. Williams, J. L. Lewis, J. Biomechanical Engineering (1982) 104, 50.

[10] Y. J. Park, Jeong Koo Kim, Advances in Materials Science and Engineering (2013) Article ID 853289.

[11] A. Alderson et al, Ind. Eng. Chem. Res. (2000) 39, 654.