Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
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TRINITY CENTRE FOR BIOENGINEERING SEMINAR SERIES 2019

Multiscale structuring techniques for biomimetic bone tissue models

Speaker: David Bassett, Healthcare Technologies Institute
Department of Chemical Engineering, University of Birmingham, UK

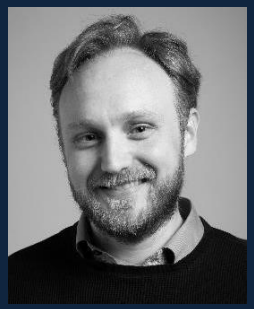
When: 4pm on Thursday 9th of May 2019

Where: B2.72-B2.74, Trinity Biomedical Sciences Institute

Advanced biomaterials for tissue engineering are now designed with the premise that they must stimulate natural tissue healing processes upon implantation and then degrade over a clinically relevant time scale, rather than to remain and replace the function of the natural tissue altogether, i.e. they must be "bioactive" rather than just "bioinert" or "biocompatible". Auto- and allo-grafts perform well in this regard due to their exact structural and exact or near biochemical composition allowing rapid integration and remodelling to occur. However this approach is far from ideal due to significant limitations of available healthy donor tissue, potential donor site morbidity, post-operative pain and disease; therefore a clear and urgent need for synthetic alternatives to repair lost function of many different tissues exists.

Cell based tissue engineering requires scaffolds that are both biofunctional i.e. provide the necessary environment for cell survival and maturation, and possess suitable mechanical properties for their application.[3] In addition to tissue engineering applications, synthetic tissue-like constructs can be used as *in vitro* models for 3D cell culture. If a suitable synthetic environment that closely mimics human tissue physiology can be created, then costly and ethically questionable *in vivo* animal studies could largely be avoided and such a tool would certainly accelerate progress in the field of regenerative medicine.

For bone, the challenge is immense due to the need to reproduce a mechanically strong and highly complex architecture across wide length scales (nm-cm). Although not classically regarded as a leading bone tissue engineering class of material, hydrogels offer a very attractive building block to construct such hierarchy biomimetically. This is because they represent a class of material with a large variety of properties and gelling mechanisms, they can be formed into virtually any shape and size, can encapsulate cells, particles and bioactive molecules and can be functionalised to tailor biological responses. The major disadvantages with using hydrogels, such as alginate, for such an application is that they are inherently mechanically weak and structurally isotropic. My talk will introduce new approaches that my lab has recently developed to introduce structural features across multiple length scales, including control of inorganic crystal growth, droplet based microfluidics, cell patterning and 3D printing to advance towards the goal of functional synthetic bone tissue analogues.



Dr Bassett is a lecturer in Healthcare Technologies at the School of Chemical Engineering. David's scientific interests and expertise lie at the interface of human biology and materials science. His main research theme is to understand the biological mechanisms that intricately control both the formation and prevention of inorganic minerals within organisms and apply this knowledge in three key areas: to develop improved biomaterials for regenerative medicine; to inspire the synthesis of novel nanostructured inorganics, and to inform the design of improved 3D cell based hard tissue models. David has a rich multidisciplinary and international background with a first degree from the University of Birmingham in Biomedical Materials Science, a PhD from McGill University, Canada in Dental Science and Postdoctoral research experience at NTNU, Norway in Biophysics where he is now also an adjunct professor.