



# Coláiste na Tríonóide, Baile Átha Cliath Trinity College Dublin

Ollscoil Átha Cliath | The University of Dublin

## OFFER OF TRAINING FORM SUMMER 2022

Proposer details:	
Title:	Injectable and conductive hydrogels as biomaterial scaffolds for cardiac tissue engineering and regenerative medicine
Name:	Michael Monaghan
Email:	<a href="mailto:monaghmi@tcd.ie">monaghmi@tcd.ie</a>
Website:	<a href="http://www.monaghanlab.com">www.monaghanlab.com</a>
If your grade does not allow you to supervise students, please supply the name of support PI:	n/a

Student required:	
Specify any previous training / experience the student should have:	
Wet lab skills, materials fabrication, biomaterials, some knowledge of biology, mechanical characterisation	
Study level (3rd year, 4th year)	Preferably 4 <sup>th</sup>
Any other requirements:	

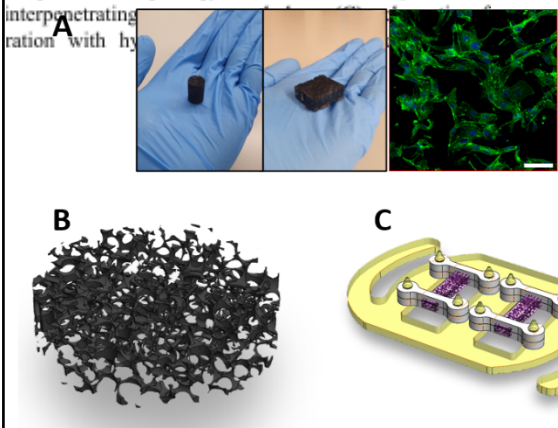
Traineeship offered:	
Brief job description: (please include (1) type of work, (2) what student should hope to achieve at end of the process, (3) who will supervise student on daily basis (post-doc etc.))	
<p><b>Background:</b> Myocardial infarction (a heart attack) is the leading cause of death in the western world, causing 1 of every 7 deaths. Current clinical solutions consist of bridge therapies for the whole organ transplantation. In the context of tissue engineering and regenerative medicine, researchers in the lab of Dr Michael Monaghan are developing cell-based strategies to obtain adult cardiac tissues differentiated from stem cell sources to repair damaged myocardium or engineer cardiac organoids in vitro.</p> <p>The recapitulation of the cardiac electro-mechanical environment can be a pivotal trigger for the mature cardiac phenotype maturation. Conductive polymers such as poly(3,4-ethylenedioxythiophene) :poly(styrenesulfonate) (PEDOT:PSS) are electrically conductive, easily processable, biocompatible and are being harnessed into both 2D and 3D structures for in vitro cardiac tissue engineering (<a href="http://www.monaghanlab.com">www.monaghanlab.com</a>). Dr Monaghan's Team have had numerous studies employing these electroconductive materials as scaffolds for tissue engineering and are now exploring the modification of these materials as injectable systems. Such an advanced would be a novel approach in employing conductive biomaterials to enhance diseased tissue and restore physiological function.</p>	

The overall goal of this project is to apply defined electric field patterns (using an established custom-bioreactor system) to 3D electroconductive scaffolds loaded with non-viral gene vectors and study their effect on prolonged and transient protein expression.

**Objectives:**

- 1) To explore methods of PEDOT:PSS suspension techniques to drive self-assembly (via electrostatic interactions) of a water containing network (hydrogel)
- 2) To characterise these hydrogels in terms of injectability, mechanical properties (rheology), morphology (SEM) and physicochemical properties (contact angle, XPS, UV-VIS)

Figure 1 ARABIC 1 (A) Electroconductive PEDOT:PSS morphologies and micrograph demonstrating culture of the spreaded morphology. (B) micro-CT x-ray scan of the interconnected morphology. (C) 3D modelling of the interconnected morphology.



- 3) To culture beating cardiomyocytes within the conductive PEDOT:PSS hydrogel and incorporated into a electrical-stimulation bioreactor already present in the Monaghan Lab.

**Methods Employed:** biomaterial fabrication, in vitro cell culture, cell isolation, electro-conductivity testing, mechanical testing (dynamic compression), statistical analysis, 3D modelling, 3D printing.

**Deliverable:** This project will lay a strong framework towards impacting the field biomaterial scaffolds in cardiac tissue engineering.

**Mentorship:** Student will work on a team with one PhD student as a main contact point and will be supported by the PI and the rest of the team.

**Prospective candidates are welcome to get in touch with Dr Monaghan at any time to schedule a zoom call to discuss the project in more detail.**

Link to research group or supervisor webpage:	<a href="http://www.monaghanlab.com">www.monaghanlab.com</a>
Location of lab:	Trinity Biomedical Sciences Institute and, Department of Mechanical, Manufacturing and Biomedical Engineering.

<b>Working hours:</b>	
Number of Weeks offered:	Minimum of 12
Hours per week:	40
Earliest Start Date possible:	1 <sup>st</sup> May 2023
Latest End Date possible:	14 <sup>th</sup> September 2023