QUB - Mechanical and Aerospace Engineering PhD Project 2019-2020

Title: Manipulating the chemistry and nanotopography of cultured diatoms for applications in tissue regeneration technologies.

Project description:
Diatoms are a unicellular microalga with a silica-base exoskeleton (called a frustule) that has a particle size in the range of 2 µm to 5 mm depending on species (e.g. shown in Fig 1.). Currently, more than 200,000 species have been classified, each with their own unique morphology. They are highly porous, with a nanopatterned surface topography creating a surface area in the range of 10 to 250m^2g^{-1} which is identically replicated from generation-to-generation within the same species. They have high photosynthetic efficiency, high biomass productivity with a doubling capability every 24hrs, rich in omega-3 (both eicosapentaenoic acid and docosahexaenoic acid) and requiring nitrogen, phosphorus, CO_2, and light for growth. Their unique topographies cannot be replicated synthetically and offer a valuable tool in biomaterials research to better understand the interface between biomaterials and their host site.

The student undertaking this inter-disciplinary project will have the opportunity to work with a team of multi-disciplinary experts from Engineering, Chemistry, Medicine and Biology, and will gain access to a wide range of state-of-the-art facility under the MATCH (Materials and Advanced Technology for Healthcare) Pioneer Research Programme and Queen's Marine Laboratory (QML).

Aims and Objectives:
This research will focus on incorporate substitute ions including Mg, Sr and Zn, which are known to influence cell response in bone healing. Previous literature has shown the diatoms will uptake other metals in the absence of silica, producing TiO_2 or other metal-based frustules. The chemistries will be manipulated *in vivo* in living diatoms. The PhD student will culture diatoms and characterise their physicochemical properties using a range of material science techniques including atomic force microscope, scanning electron microscope, transmission electron microscopy and x-ray diffraction. The project will be highly tailored to the individual candidate, depending on their interests, there may be opportunities to focus on chemical analysis and how the change in ion effects their dissolution properties or to focus on the biological cell response on the different chemistries grown.

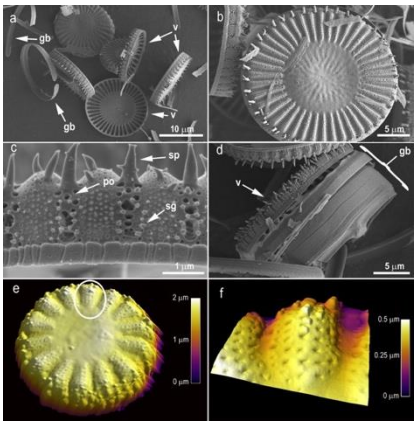

Fig. 1 (Images taken by P. Walsh, published Walsh et al. Scientific Reports, 7: 14138 (2017)).

Key skills required for the post: Students with at least an upper second (2:1) class degree in a relevant discipline (e.g. Chemical Engineering, Chemistry, Mechanical Engineering, Biology, Biochemistry, or related subject) are invited to apply. Research experience at Undergraduate level or a Master's degree in a related area would be highly beneficial. The candidate should be proficient in both oral and written communication.

Key transferable skills that will be developed during the PhD:

- Familiarity with working in a multidisciplinary research environment
- Project and time management skills
- Experimental design and interpretation of research findings
- Effective dissemination of research through presentation at international conferences and publication in high quality technical journals.
- Awareness of the societal impacts and commercialisation roadmap for healthcare technologies

Lead supervisor:	Dr Pamela Walsh, School of Chemistry and Chemical Engineering Telephone +442890975570, email: pamela.walsh@qub.ac.uk
Other supervisor(s):	Professor Fraser Buchanan, School of Mechanical and Aerospace Engineering Telephone +442890974130, email: f.buchanan@qub.ac.uk
Guaranteed stipend:	This EPSRC Studentship will include a stipend of approx. £14,925 (2019-20), with funding available for 3.5 years. Eligibility includes UK residency

	(https://epsrc.ukri.org/skills/students/help/eligibility/)
Conditional top-up available:	
PhD students will have the opportunity to apply to be demonstrators on undergraduate modules. Compensation for this can amount to £2,400 per year.	

Queens University Belfast is a diverse and international institution which is strongly committed to equality and diversity, and to selection on merit. Currently women are under-represented in research positions in the School and accordingly applications from women are particularly welcome.