CDT Project Proposal in Advanced Biomedical Materials
2019/20 Cohort Studentship Project Application Guidelines

Thank you for your interest in the EPSRC CDT studentship scheme. This year, nine students have been recruited onto the CDT and begin their taught unit training in 'Research Methods', 'Clinical Applications of Biomaterials', 'Imaging, Characterisation, and Key Manufacturing Techniques' and 'Responsible Research and Innovation' in October 2019. Students have undergraduate backgrounds ranging from a variety of disciplines such as biomaterials, bioengineering, dental technology, biomedical science, bioengineering and zoology.

Their research projects begin on 1st March 2020 and there will be a series of project choice events over autumn 2019 organised where students and potential supervisors will be able to meet and discuss potential projects. These EPSRC funded studentships will build on our CDT strategic themes as highlighted by the Royce landscape document (please find attached). From this, priority areas in *bioelectronics*, *fibre technology*, *additive manufacturing* and improved *pre-clinical characterization* were identified. Additionally, the need for improved manufacturing scale up and reproducibility was highlighted. The CDT will focus on these specific areas. **The CDT vision is to provide an employable and highly skilled workforce of future industrial and academic leaders in advanced biomedical materials.** The CDT is led by The University of Manchester, the UK Royce Institute lead for biomedical materials. Manchester is joined by The University of Sheffield, a Royce partner with expertise across materials and biomaterials (polymers, metals, ceramics), manufacturing and characterisation programmes. The CDT is focussed on developing Training which will provide a strongly linked multidisciplinary cohort of biomedical materials engineers to address a recognised skills shortage. All research projects will have clinical, biological, regulatory and industry engagement where appropriate. In addition to training a highly skilled workforce, clinically and industrially led research will be performed that focuses on translating smart and responsive biomaterials with a focus on higher throughput, greater reproducibility in manufacture, and characterisation for downstream applications, for the health care sector. Biomedical Materials have advanced dramatically over the last 50 years. Historically, they were considered as materials that formed the basis of a simple device, e.g. a hip joint or a wound dressing with a predominant tissue interface. However, biomedical materials have grown to now include the development of smart and responsive materials. Consequently, such materials provide feedback regarding their changing physiological environment and are able to respond and adapt accordingly, for a range of healthcare applications. Two major areas underpinning this rapid development/progression are advances in biomedical materials manufacture and their characterisation.

Guidance for form completion

Project and Supervisory Criteria

Proposals submitted will be reviewed by the CDT committee based on the following criteria:

- Interdisciplinary supervisory team;
- Appropriateness of partner input and strength of business case;
- Pairing of senior and early-career academics where appropriate;
- Training in at least one skills thematic priority area (Bioelectronics, Fibre technology, Additive manufacturing, Improved pre-clinical characterization)

Project type

Applicants should choose one, two or all of the following criteria as appropriate to describe their project:

- Fundamental research
- Industrial application
- Clinical translation

Projects translating products of advanced biomedical materials is the emphasis of the CDT. These products may be early academic stage (eg fundamental research) or maybe later stage involving direct industrial input.

Thematic area

- *Bioelectronics*: an interdisciplinary research area focusing on the electronic monitoring and control of biological systems, and the engineering of the bio-interface. This necessitates crossing the boundary

between “wet” biology and “dry” electronics to enable mass data collection (sensing) and in the longer term precise, closed loop, actuation/control of the biological agent. In general, the bioelectronics area is needs driven, together with technology push, with particular drivers being in personalised health are (enabled by data driven treatment delivery, non-pharmacological interventions through direct tissue interfacing and similar) and in-vitro cell monitoring. Projects should could represent a step change from current biomedical reliance on ‘non-smart’ biomaterials (limiting longevity of medical implant) to ‘smart’ biomaterials for regenerative and precision medicine and remote sensing/monitoring (e-health).

- *Fibre technology:* Fibrous materials is a key growth area in biomedical materials due to its benefits ranging from increase in surface area and thus associated absorbency / controlled release profiles and its biomimicry relating to collagen fibre morphology. As an example, currently, for industry to scale up production of electrospun products for design validation, the manufacture has to be outsourced to companies outside of the UK such as Spain, South Africa or New Zealand. In addition, other novel methods of fibrous material production are being developed and in particular UK SMEs would benefit from access to a novel suite in this area. Projects including process development of industrially scalable nanofibres systems such as solution blow spinning, centrifugal, and electrospinning for hierarchical/graded structures could be considered.
- *Additive manufacturing:* the process of joining materials to make objects from 3D model data (usually layer upon layer e.g. 3D-printing) and the application of the technology to construct implants/medical devices from biomedical materials. Projects falling into this category should describe novel AM processes to include printing of hard materials (metals and ceramics), hydrogels/bio-inks, cellular materials, with improved resolution and speed of manufacturing.
- *Improved pre-clinical characterization:* the development of novel characterisation technology or methodology to improve the way characterising biomedical materials at a pre-clinical stage.
- *Other projects in the area of advanced biomedical materials*: projects that contribute to developing advanced biomedical materials that fall outside these four priority areas will still be considered as long as they fit the overall remit of ‘advanced biomedical materials’ as defined in the section above.

Supervisors

All proposals are expected to meet the University’s requirements for PhD supervision, summarised as:

Members of the supervisory team will have a proven track record of undertaking research at internationally recognised levels of excellence and regularly publish the results in leading outlets, in addition to supervising research students through to timely and successful completion of their degrees.

The Primary Supervisor must meet the eligibility criteria as set out in Section 3 of the Supervision Policy. Project proposals will be reviewed to ensure they fit within the identified EPSRC CDT themes and that the Primary Supervisor:

- can provide a vibrant research environment and has active research grant support (at the start date of the studentship)
- has evidence of significant publications
- has effective eProg engagement
- currently holds an externally-funded studentship awarded in open competition (e.g. from charitable/industrial sources) ***or*** is actively seeking external/self-funded students via self-funded project advert(s).

Early-career researchers (ECRs); normally defined as lecturer or independently (externally) funded fellow within 10 years of receiving their doctoral degree. ECR status will be confirmed by HoD as part of the project approval process)**.**

ECRs that do not meet the Primary Supervisor eligibility criteria set out in the published UoM Policy should note the following updates:

- ECRs can be listed as Primary Supervisor for the purpose of the application and advertisement; must have an appropriate co-supervisor who meets the eligibility criteria as set out in Section 3 of the Supervision Policy.
- If successful in being awarded a studentship, the ECR will be recorded as a co-supervisor on the student’s record (i.e. can have majority credit share).
- Staff supporting an ECR can also submit their ‘own’ CDT project, if applicable.
- The new UoM policy allows ECRs to convert to Primary Supervisor at the end of the student’s first year of study if the:

- student has progressed, without any concerns or remedial action, into the second year of their programme;
- ECR has completed the relevant aspects of the New Academics Programme;
- ECR holds a contract that exceeds the student's anticipated submission date;
- original Primary Supervisor remains part of the supervisory team and actively supports/mentors the ECR in their role as primary supervisor.

Multidisciplinary training

Indicate which aspects of training are provided by each member of the supervisory team. Include the training provided for the students in clinical aspects, regulatory affairs, translation and patient participation and involvement (PPI) where appropriate. Indicate in this section if you wish the CDT committee to assist in placing you in contact with regulatory consultants, translation manager consultants and PPI interaction.

Describe translation line of sight / road map for project

Describe the current technology readiness level (TRL) of the project proposed and anticipated TRL at the project end. Include any details regarding the plan for future translation where possible. Translational research at the University of Manchester and Sheffield encompasses a wide range of activities stemming from discoveries in the fundamental sciences/engineering and progressing through a pipeline that includes hypothesis testing and elucidation of cell response mechanisms to engineering approaches, preclinical research in animal models, through to clinical trials in humans of new biomedical material products and ultimately delivery and adoption within the NHS. This is described in the translation continuum seen in **Figure 1**.

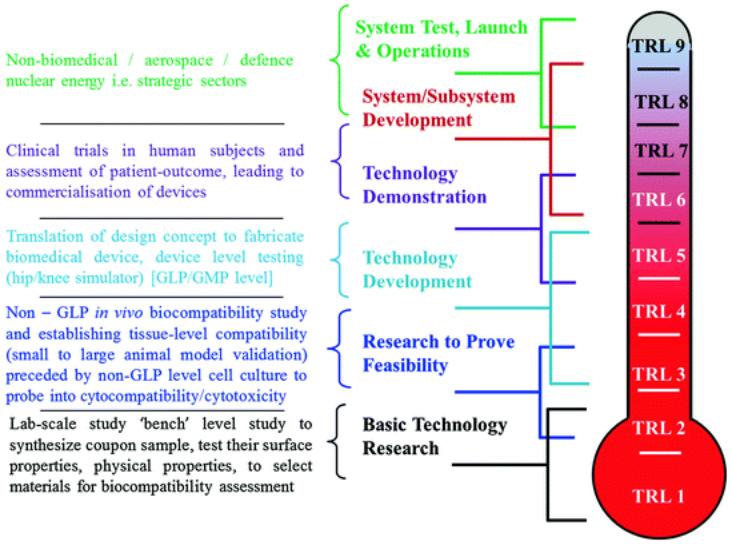

Figure 1: An example of technology readiness levels in biomedical materials sector

Funding from EPSRC

- 3.5 year award (March 1st 2020 – September 30th 2023)
- Includes fees for UK and eligible EU students
- Includes student maintenance stipend (at RCUK rate)
- Annual RTSG of £6.7k per annum for 3.5 years of the research project (consisting of £5k consumables, £1.5k travel for project specific conference, £200 outreach activity pro rata to the Primary Supervisor

Project Partner Details

Although not necessary, the EPSRC CDT encourages collaboration with industry, other academic and clinicians to ensure synergy in research projects and training potential for students.

An *industry partner* is a company that contributes financially as detailed in the section below. This industrial partner can co-supervise the CDT student and co create the project with the academic supervisors and the student. They can be involved in regular supervisory meetings and input into development of the project. An *industry collaborator* is one that does not contribute financially in the same manner but may participate in steering meetings for the project. They should not be involved in co-creation of the project in the same manner or have access to The University of Manchester / Sheffield facilities in the same manner as industrial partners.

There is an opportunity for industry collaborators to host students in 3month secondments to assist in their engagement with the CDT.

An external (national or international) academic partner is possible for these projects. Up to £3k for each student on the CDT is available to assist in either industrial or academic 3month secondments. A longer placement up to six months is possible and each secondment will be considered and approved by the CDT committee. Please detail the rationale for inclusion of any academic partner in this section for the benefit of the research project and training potential for the student. Please note that project applications do not have to identify their 3month secondment at this early stage if this has not already been identified – please only include at this stage if this has already been identified.

A clinical collaborator is encouraged as we wish our projects to have clinical input to ensure effective product translation. If a clinical supervisor or collaborator has already been identified – please include details on the form. If you wish assistance in identifying a relevant clinician that could offer either occasional advice or act as a co-supervisor please indicate on the form and the CDT committee will assist with these connections.

Industry Partner Financial contributions

Please note that small and medium-sized enterprises (less than 250 employees) are required to contribute £5k pa and companies with >250 employees are required to contribute £10kpa. Further detail on the benefits of this investment is included on the industry partner form. Companies are expected to pay for provision of in-kind contributions, e.g. coverage for supervision.

Industry Partner IP

Partner companies will be given an option period to internally evaluate the foreground intellectual property and subsequently negotiate an exclusive commercial licence. Identification, filing and licencing of intellectual property will be managed by The University of Manchester / The University of Sheffield's agents for IP commercialisation. All parties will be encouraged to share the research with the external scientific community and to publish and present their work in accordance with normal academic practice. Publications may be delayed only for the purpose of obtaining IP protection and will not exceed a period of 3 months. Nothing will prevent a student from submitting a thesis for examination though if required, access may be restricted.

Confirmation of Project Award

Approval of the project does not guarantee a studentship as, to ensure student experience of the CDT, more projects will be advertised to the nine students than there are students available. Each supervisory team (UoM/UoS academic and industry staff) will have the opportunity during autumn 2019 to meet with the candidates to enable their student project choice ranking in February 2020. Further details regarding the project choice events and process will be circulated following submission/approval of projects.

Please complete and submit the attached documents to the CDT committee (**CDT-AdvBiomedMat@manchester.ac.uk**) with 'EPSRC CDT Advanced Biomedical Materials Project Proposal' in the subject line. The deadline for submission is **Friday 15th November 2019**. Please do not convert the forms to pdf.

All queries should be directed to Dr Susan Hogan at Susan.Hogan@manchester.ac.uk who is the EPSRC CDT in Advanced Biomedical Materials Project Manager.