5 PhD Studentships from September 2020 in Graphene Materials at QMUL.

Queen Mary University of London is launching a miniCDT in graphene materials with significant co-funding from the EU Graphene Core 3 Flagship programme. QMUL will establish this new activity with a cohort of five fully funded PhD studentships in the School of Engineering and Materials from September 2020.

Polymer composites are widely used for the manufacture of macroscale components with enhanced properties. For example, the combination of carbon fillers or nanofibers with polymeric materials is used extensively to create versatile, light-weight and high-strength materials, for applications in aerospace, automotive, renewable energy and sports equipment sectors. Two-dimensional nanomaterials such as graphene offer significant potential when incorporated into novel polymer nanocomposites due to their exceptional intrinsic mechanical, thermal, electrical and barrier properties.

The range of projects will suit graduates from a wide range of chemistry, physics, chemical engineering, engineering or materials science backgrounds. In particular applicants with an interest in nanocomposites, graphene materials, polymers and materials engineering are encouraged to apply. The projects will be based at the London campus of QMUL. A supervisory group of 9 academics has been established under the leadership of Prof James Busfield and Prof Nicola Pugno.

Project 1 Details: Soft actuators and energy-responsive systems based on 2D materials (Dr Dimitrios Papageorgiou, Dr Emiliano Bilotti & Prof Nicola Pugno)

Soft materials that respond to external stimuli such as electric current or pressure and then deform are of significant interest in the fields of smart systems and devices. These systems can adjust to changing environments, are tough and compliant and suitable for mass production. As a result, these materials are excellent candidates for wearable devices, energy harvesting, smart manufacturing and products such as artificial muscles and minimally invasive surgical robots. QMUL research will explore the production and use of novel nanocomposite materials utilising multifunctional reinforcements. The use of two-dimensional (2D) materials will efficiently couple stimuli to soft, responsive polymeric matrices to realise soft actuators that respond to electricity, heat, light or other forms of energy. New processing techniques will be developed to gain precision, control and material design over the actuation performance.

Project 2 Details: The design and manufacture of graphene related materials in high strength super hydrophobic materials (Dr Colin Crick, Dr Himadri Gupta & Prof Nicola Pugno)

Miniaturised surface morphologies are a key design feature in many advanced materials. This is exemplified by superhydrophobic materials, whose functionality is reliant on an intense surface roughness. Their highly water repellent properties stem from surface features trapping air under any water making contact with the surface. This repellence is lost when the micro/nano-sized features are degraded, making these materials susceptible to physical damage. Current superhydrophobic materials require regular reapplication. QMUL research will explore the physical strength of nanostructured graphene related materials incorporated into these surface features. Modelling will explore the thermo-mechanical properties in combination with the fabrication and experimental examination to provide a greater understanding of their behaviour to broaden the range of applications and develop more durable real world superhydrophobic surfaces.

Project 3 Details: Developing crashworthy and thermally conductive graphene related composite materials for electrical car battery assembly (Dr Wei Tan, Prof James Busfield & Prof Nicola Pugno)

Car batteries can easily catch fire during crash events and are often over-heat during charge-discharge cycles. In the winter, the batteries also need to be heated to reach their optimal operational conditions. QMUL research will design new graphene related materials to manufacture battery protection structures for both energy-absorption and thermal management. The concept being similar to the design of cardboard box to protect eggs and maintain them at an ideal temperature. Architected structures such as lattices and cellular materials offer a vast design space to tune and optimise the

energy absorption capacity and thermal management. These structures will be optimised using finite element models that can provide guidance for optimal levels of graphene incorporation and surface deposition texturing. This can predict the fracture and crushing mechanical behaviour coupled with the thermal behaviour when subjected to extreme thermal-mechanical loadings. The models will be validated using experiments on prototype systems.

Project 4 Details: Graphene based transparent electrodes for tuneable optical devices (Prof James Busfield, Prof Federico Carpi & Prof Nicola Pugno)

A series of novel dielectric elastomer actuator (DEA) devices such as refreshable Braille readers, haptic displays and optical devices such as smart lens that can control focal length and astigmatism and smart windows that can control transparency have been developed at QMUL. DEA devices work by applying an electrical field across an elastomer generating actuation. Previously, the electrodes used to generate the electrical fields were made from percolating carbon elastomer networks (that are opaque) or by using conductive polymers with poor conductivity. QMUL research will explore graphene materials both for their optical transparency as well as their electrical conductivity to create the next generation of compact DEA derived optical devices.

Project 5 Details: Multifunctional composites with integrated sensing and repair capabilities (Dr Han Zhang, Dr Emiliano Bilotti & Prof Nicola Pugno)

Do you want to be part of the next generation of composite materials, contributing to the development of futuristic performances like bioinspired integrated sensory network for online structural health monitoring, environmental friendly de-icing for aircraft and wind turbines that no longer use solvents, and self-healing systems that can repair internal damages? QMUL research aims to turn these ideas into reality, with strong training and access to processing equipment for both thermoplastic and thermoset nano-composites, as well as advanced characterisation technique. From the design, processing, to testing of the hierarchical composites, you will be a core part of the process to realise these integrated functionalities for future composites for example as filaments used in additive manufacturing.

QMUL Research Studentship Details

- Available to Home/EU Applicants only.
- Full Time programme only
- Applicant required to start in October 2020
- The studentship arrangement will cover tuition fees and provide an annual stipend for up to three years (Currently set as £17,285 in 2020/21).
- The minimum requirement for these studentship opportunities is a good Honours degree (minimum 2(i) honours or equivalent) or MSc/MRes in a relevant discipline.
- If English is not your first language you will require a valid English certificate equivalent to IELTS 6.5+ overall with a minimum score of 6.0 in Writing and 5.5 in all sections (Reading, Listening, Speaking).
- Please note that this studentship is only available to Home/EU Applicants. (See: http://www.welfare.qmul.ac.uk/money/feestatus/ for details)

Supervisor Contact Details:

For informal enquiries about these positions, please contact either the first named supervisor for each project or **Prof James Busfield**
Tel: 020 7882 **8866**
E-mail: **j.busfield@qmul.ac.uk**

Application Method:

To apply for this studentship and for entry on to the **Materials Science** programme (Full Time) please follow the instructions detailed on the following webpage:

Research degrees in Materials:
http://www.qmul.ac.uk/postgraduate/research/subjects/materials.html

Further Guidance: http://www.qmul.ac.uk/postgraduate/research/

Applicants should identify the projects from the ones listed above that appeal most and as part of a personal statement explain why they are suited for this role, and how will this PhD help your future career. Please be sure to include a reference to **'2020 SEMS Graphene CDT'** to associate your application with these studentship opportunities.

Deadline for applications: 10th July 2020

HIGHLIGHT UP TO 10 OF THE MOST RELEVANT CATEGORIES FROM THE FOLLOWING:

Biological & Medical Sciences	**Chemical Sciences**	**Engineering**
Biochemistry	Agricultural Chemistry	Acoustics
Bioinformatics	Analytical Chemistry	Aeronautical Engineering
Biomedical Engineering	Biochemistry	Biomedical Engineering
Biophysics	Chemical Engineering	Chemical Engineering
Biotechnology	Chemical Toxicology	Civil & Structural Engineering
Botany / Plant Science	Computational Chemistry	Electrical & Electronic
Cancer / Oncology	Electrochemistry	Energy
Cell Biology / Development	Environmental Chemistry	Manufacturing
Dentistry	Food Chemistry	Materials Science
Ecology & Conservation	Geochemistry	Mechanical Engineering
Endocrinology	Inorganic Chemistry	Nanotechnology
Evolution	Macromolecular Chemistry	Nuclear Engineering
Food Science / Nutrition	Materials Science	Semiconductors
Genetics	Organic Chemistry	Software Engineering
Immunology	Pharmaceutical Chemistry	Telecommunications
Marine Biology	Physical Chemistry	
Medical / Biomedical Physics	Synthetic Chemistry	**Maths & Computing**
Medical / Clinical Science		Applied Mathematics
Medical Imaging	**Physical Sciences**	Bioinformatics
Microbiology	Applied Physics	Computational Chemistry
Molecular Biology	Astrophysics	Computer Science & IT
Neuroscience / Neurology	Atmospheric Physics	Data Analysis
Obstetrics, Gynaecology & Reproduction	Atomic Physics	Information Science
Parasitology	Biophysics	Mathematics
Pathology	Condensed Matter Physics	Operational Research
Pharmacology / Toxicology	Fluid Dynamics	Software Engineering
Physiology & Sports Science	Geophysics	Statistics
Psychology & Psychiatry	Low-temperature Physics	
Public Health & Epidemiology	Materials Science	
Structural Biology	Medical / Biomedical Physics	
Veterinary Medicine	Metrology	
Virology	Nuclear Physics	
Zoology / Animal Science	Optical Physics	
	Particle Physics	
	Plasma Physics	
	Radiation	
	Semiconductors	
	Theoretical Physics	