

## Imperial College London and University College London

### PhD Studentships

#### Department of Materials and London Centre for Nanotechnology

**Duration: 48 months (starting on 1<sup>st</sup> October 2019)**

The Department of Materials jointly with the London Centre of Nanotechnology has a number of four-year fully-funded studentships available. This funding requires you to be a home student\*. Successful applicants will be registered at either Imperial College London or University College London.

The PhD programme offers training in the application of state-of-the-art characterisation techniques to materials challenges in key thematic areas of societal importance such as Energy, Information Technology, Nanomaterials, Healthcare, Security, Environment and Transport. Each project will involve experts at both University College London and Imperial College London and you will spend time at both sites during your project. You will also have a three-month placement at a leading international university, research institute or industrial partner. Specially designed training modules in characterisation will be interwoven with your PhD research project, and you will receive professional development training delivered by our award-winning Graduate Schools. Our training philosophy is that our graduates will provide the innovation and creativity required to lead the world in the development, characterisation and manufacture of new materials, making a significant contribution to the quality of life of future generations.

#### **Project Title:**

**The crystal structure of graphitic carbon as a function of its compositions and associated materials**

**CDT Theme:** Magnetic Materials

#### **Project Supervisors:**

Supervisor 1: Dr. Dominic Papineau (UCL): e-mail: [d.papineau@ucl.ac.uk](mailto:d.papineau@ucl.ac.uk)

Supervisor 2: Dr. Sarah Fearn (ICL): e-mail: [s.fearn@imperial.ac.uk](mailto:s.fearn@imperial.ac.uk)

**Research project abstract:** The heteroatomic and molecular compositions of graphitic carbon are known to affect its crystal structure and inhibit the formation of graphite or books of graphene sheets. However, exposure to high temperature regimes, especially in contact with materials that contain redox-sensitive elements, can lead to the depletion of molecular functional group bonded to graphitic carbon, thereby eventually forming graphite. What are the detailed relations between crystal structure and molecular or heteroatomic compositions of graphitic carbon? The influence of various materials on the conversion of graphitic carbon into graphite is poorly understood, although it is important for a number of applications in graphene nanotechnology and materials surface reactivity. We will investigate this problem using a correlated microscopy approach that combines micro-Raman spectroscopy and Time-of-Flight Secondary Ion Mass Spectrometry (ToF-SIMS) to image the changes in the compositions of graphitic carbon exposed to different conditions and materials. This research will contribute to the development of an advanced characterization approach of graphitic carbon in contact with various materials and to the determination of its molecular and atomic compositions. One of the objective will be to reconcile the variably-shaped Raman D-bands and G-band of graphitic carbon with heteroatomic and molecular compositions determined by ToF-SIMS. This will yield a more comprehensive understanding of the variable

characteristics of Raman spectra for graphitic carbon. Some specimens of graphitic carbon will come from the oldest sedimentary rocks on Earth, as well as from Mars, thereby also relate to the origin of life on Earth and other planets. The research project is highly multidisciplinary and encompasses the fields of Material Sciences (magnetic and crystalline materials), Physics (spectroscopy and surface analysis with photons, ions, and electrons), Chemistry (crystal chemistry and organic molecules), Earth Sciences (Precambrian biogeochemistry and Earth history), and Exobiology (origin of life and biosignatures).

**Involvement of partners:** The project requires the involvement of both UCL and ICL. Dr Dominic Papineau manages a micro-Raman laboratory and curates a collection of graphitic carbons in the Department of Earth Sciences at UCL and also uses the clean lab for nano-fabrication by Focused Ion Beam in the LCN at UCL. Dr Sarah Fearn is an expert in ion beam characterisation and manages the ToF-SIMS instrument in the Department of Materials at ICL. She is also leading the development of a new High 5 plasma ion beam instrument there. Opportunities with a new LA-ICPMS for characterization of trace elements in organic matter will also arise from collaboration with Dr Theodora Steward at King's College London, which is newly part of the LCN. This PhD student opportunity will enhance collaborative and cross-institutional links.

**Requirements:** The candidate will hold, or be expected to achieve, a Master's of Science degree in addition to a Bachelor's of Science degree (or equivalent) at 2:1 level (or above) in Earth or planetary sciences, chemistry, or physics. Experience with optical and electron microscopy are suitable and strong motivation is required. Students will take taught courses at both UCL and ICL during the first three-months period.

To make informal enquires please contact Dr Dominic Papineau at [d.papineau@ucl.ac.uk](mailto:d.papineau@ucl.ac.uk)

**Applications will be handled in two stages:**

**Stage 1:** Send a full CV, including the marks (%) for all (undergraduate) modules completed to date, the names and contact details of two referees, as well as a cover letter (2 pages maximum) to Claire Smithson at UCL [c.smithson@ucl.ac.uk](mailto:c.smithson@ucl.ac.uk). Applications that do not provide all this information will not be considered.

**Stage 2:** Suitable applicants will be interviewed and, if successful, invited to make a formal application.

**\* European Union nationals who have been ordinarily resident in the UK for at least five years prior to starting a PhD studentship. Overseas students with full funding are welcome to apply.**

**Closing date: Ongoing until post is filled**

*Both ICL and UCL are committed to equality and valuing diversity. Both are Athena SWAN Silver Award winners and Stonewall Diversity Champions. ICL is a Two Ticks Employer, and is working in partnership with GIRES to promote respect for trans people. UCL holds a race equality bronze award.*