**CDT ACM PhD Research Project – Dr Papineau and Dr Fearn**

**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

Supervisor 2: Dr. Sarah Fearn (ICL): e-mail: 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 under different conditions. 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 graphite specimens will come from the oldest sedimentary rocks on Earth, thereby also relate to the origin of life.

**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 has access to the nano-fabrication clean lab in the LCN at UCL. Dr Sarah Fearn is an expert in ion beam characterisation, and is also associated with the development of a new High 5 plasma ion beam instrument at ICL. While some nano-fabrication by Focused Beam will take place at UCL, all of the high-resolution ion beam chemical characterization to be done in the PhD project is based at ICL. Opportunities with LA-ICPMS for characterization will also arise from new collaborations with King’s College London, which is newly part of the LCN. This PhD student opportunity will enhance collaborative and cross-institutional links.

**The main skills to be acquired:** Transferable skills including correlated microscopy, FIB-based nano-fabrication, analysis by ToF-SIMS, micro-Raman, and other techniques. Transferable skills will also be developed associated with the data and image processing necessary during the project.

To make informal enquires please contact Dr Dominic Papineau at d.papineau@ucl.ac.uk