MANCHESTER 1824
The University of Manchester

Project Title	Developing Cleaner Graphite For Next Generation Nuclear Reactors.
Lead Supervisor	Dr Abbie Jones
Co-Supervisor(s)	Professor Barry Marsden and Dr Clint Sharrad (CEAS)
Programme	PhD in Nuclear Engineering
Research Theme	Nuclear Engineering
Description	We are offering a fully funded PhD scholarship starting in September 2018 to examine the behaviour and performance of graphite to be used in Gen IV nuclear systems. Graphite has been used for neutron moderation and structural support since the beginning of the nuclear reactor era. While the research activities have abated over the years, there is a renewed interest in graphite motivated by its use in the next generation of Very High Temperature and Molten Salt Reactors. The retention of the activated fission products (FP) is paramount during normal operating and accident conditions, and a mechanistic understanding of the physio-chemical and transport processes is vital for predicting the release rates and designing appropriate barriers to ensure inherent safety and lifetime performance. A number of experimental studies conducted with TRISO fuel show that pyrolytic carbon layers offer some resistance to noble gases while FPs such as caesium, silver and strontium escape under normal and accident conditions. Metallic FPs such as caesium and silver are thought to get trapped in the intercalated structure of graphite but are extremely volatile at temperatures greater than 900^{o}C. Finally, FPs can interact with air/water during an accident situation and potentially enhance the release rates. At the microstructure level, transport and retention behaviour is thought to be dependent on the graphitic filler phase, binder insoluble particles, micro Mrozowski cracks and macrocracks however the fundamental mechanisms of FP interactions and the dependence of diffusion/transport on microstructure have not been quantified to date in adequate detail. **The project** A new research partnership funded jointly between the DOE (USA) and EPSRC (UK) aims to study the mechanisms of retention and transport of fission products in virgin and irradiated nuclear graphite. The PhD project sits within a newly funded 1.5M research consortium involving UoM (Jones), Loughborough, University of Central Florida and North Carolina State University. The successful candidate will be able to work directly with collaborators from these top US universities and Oak Ridge National Laboratory. Key aims of the project at Manchester is to better understand mechanisms associated fission product transportation in nuclear graphite, we will study the microstructural and spectroscopic properties of graphite using state of the art 4D X-ray and TEM tomography in order to understand the migration, retention and release of particular fission products in graphite with the aim to correlate microstructure characteristics to long term graphite behaviour. Complimentary analysis such as Raman spectroscopy, X-ray photon spectroscopy (XPS), nitrogen porosimetry and diffractometry may also be used to understand FP interactions.

Skills required	A undergraduate degree at 2:1 or above and Masters award at Merit level in a STEM subject preferably with Laboratory experience Knowledge of nuclear systems is advantageous The other entry requirements can be found by selecting the relevant PhD programme at: http://www.mace.manchester.ac.uk/study/postgraduate-research/degree/
Industrial Links	The studentship is co-funded by USA DOE National Laboratories and ESPRC. Funding covers stipend and full tuition fees for home/EU students Further information about how to apply can be found at: http://www.mace.manchester.ac.uk/study/postgraduate-research/apply/ General enquiries relating to the postgraduate application process within the School of Mechanical, Aerospace & Civil Engineering should be directed to: Martin Lockey, Senior PG Recruitment & Admissions Administrator (E-mail: martin.lockey@manchester.ac.uk, Tel: +44(0)161 275 4345)
Closing date for applications*	Applications are currently accepted for September 2018 start.
Project specific enquiries*	Please contact Dr Abbie Jones: Abbie.jones@manchester.ac.uk