UNIVERSITY of York

Mark Christie PhD Scholarship in Low Temperature Plasma Science

Project Title: **Low-temperature plasma nitrogen fixation for agricultural applications**
Supervisor: Dr Deborah O'Connell
Supervisor contact details: deborah.oconnell @york.ac.uk

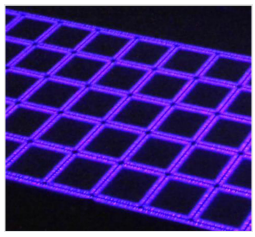
This collaborative inter-disciplinary PhD project involves innovative research at the interface of physics, environment, chemistry and biology. The student will be part of the York Plasma Institute in the Department of Physics, with access to state-of-the-art experimental and computational facilities. The project will be carried out in close collaboration with research groups in the Departments of Environment, Chemistry and Biology and the University of York. The project builds on a recently successfully collaborative project between the research groups.

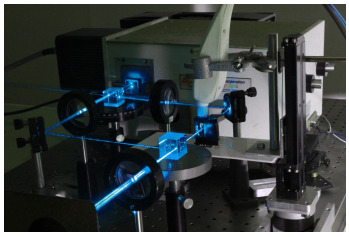
Low-temperature plasmas have established applications ranging from computer chips and mobile phones to spacecraft population and medicine. Low-temperature or 'cold' plasmas are weakly ionised gases far from thermodynamic equilibrium. They are composed of a few hot electrons (few eV or ~10,000 C), while the heavier ions and neutrals (the dominant component) are close to room temperatures. These plasmas offer many technological applications, primarily motivated by their efficiency to generate reactive species in ambient dry environments at low temperatures, otherwise not achievable.

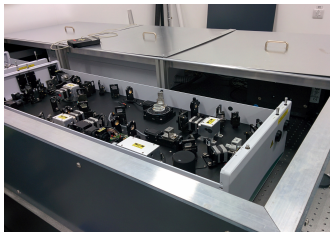
Artificial nitrogen fixation, for synthesis of ammonia mainly for fertiliser production, is a very important and demanding chemical process consuming around 1 – 2% of the world's annual total energy supply. It is well known that lightning in the atmosphere improves plant growth through nitrogen fixation. We can mimic this process through sustaining low-temperature plasmas in ambient air. Plasmas can convert atmospheric nitrogen and oxygen molecules into nitrates, which are dissolvable in rain or water aerosol, and can then be carried to the soil. A key advantage of using plasmas is sustainability and independence of chemical plant infrastructure and production supply chains.

Sustaining and tailoring plasmas in ambient air is challenging, as these plasmas are susceptible to thermal instabilities, which need to be controlled. This project will involve the application of experimental and simulation techniques to explore the production of relevant chemically reactive species in air plasmas, how they can trigger downstream chemical and biological processes, and associated enhanced plant growth. State-of-the-art recently developed diagnostic analytical techniques will be applied and further developed to quantify reactive species within the plasma phase, and their transport into water and soil.

The project is suitable for candidates interested in physical and analytical chemistry, spectroscopic techniques and free radical chemistry. Training will be provided in all areas, and a willingness to learn new techniques and disciplines are more important than any prior experience. The successful candidate will have at least a 2:1 honours degree in a relevant science or engineering subject.







For further information on applications please see http://www.york.ac.uk/physics/postgraduate/ or contact deborah.oconnell@york.co.uk.

The Department of Physics holds an Athena SWAN Silver Award and is committed to supporting equality and diversity for all staff and students