ENGINEERED DIAMOND TECHNOLOGIES PROSPERITY PARTNERSHIP

Environmental Electrochemistry: Development and Application of Electrode Technology for Pollutant Removal from Water Systems

Supervisor: Prof Julie V. Macpherson (Warwick Chemistry)
Second supervisor: Dr Tim Mollart (Element Six)
Funding: Fully funded PhD studentship (48 months)
Start date: September/October 2022.
Application deadline: Ongoing

Persistent organic pollutants (POPs), with their ability to bioaccumulate and biomagnify pose a considerable threat to both our health and that of aquatic based species. Water treatment using electrochemical methods is an emerging technology for the destruction of POPs that is growing significantly in importance as national and international regulations rightly tighten. The main concept is to convert a target pollutant to a harmless species via either direct oxidation/reduction or generation of a highly oxidising species in-situ, which in turn will attack the pollutant. Water systems can include, for example, industrial waste water, rivers, drinking water or environmentally contaminated water. Electrodes of interest in such applications must be sufficiently robust such that they suffer minimal degradation themselves at the potentials required for pollutant removal. In this regard, sp^3 hybridized carbon, diamond doped with sufficient boron to be electrically conducting – boron doped diamond (BDD) - is a very attractive prospect. A significant challenge to also overcome concerns design of the electrochemical system, such that it maximises mass transport of the pollutant to the electrode surface. This is because pollutants are often found at low concentrations, even after remedial separation processes have been completed. The project will involve but is not limited to:

- Assessing the performance properties of BDD electrodes for the destruction of key target POPs currently of world-wide importance in both model and real systems
- Extension to other pollutant systems such as pharmaceutical ingredients (drugs/hormones) which are also currently found in our water systems and pose considerable threat
- Understanding the factors which control the lifetime of such electrodes in different pollutant removal systems.
- Development of cost-effective, high surface area, electrode technology
- Finite element modelling of electrochemical systems
- Training in electrochemically generated radical detection
- Combination of electrochemical with solution based advanced oxidation methods

The research will be carried out in the Chemistry Department at the University of Warwick in close collaboration with our industrial partner Element Six. This project is supported by the recently funded UKRI/EPSRC Engineered Diamond Technologies Prosperity Partnership grant – which aims to advance and solidify the UK's world-leading role in diamond technologies to develop solutions where no other material is capable – and the Warwick Centre for Doctoral Training in Diamond Science and Technology. The project will exploit the world-leading diamond synthesis capabilities of Element Six and Warwick's pioneering expertise in BDD electrochemistry and material characterisation. The student will join the Prosperity Partnership team (which consists of 5 academic research groups spread across Warwick Chemistry, Physics and Engineering) and benefit from interactions well as over 40 researchers in the wider diamond community at Warwick.

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Applicants must have (or expect to obtain) at least the equivalent of a UK first or upper second-class degree in Chemistry, Physics or Chemical Engineering (or related subjects). The studentship will commence in October 2022 (although an earlier start is possible based on your availability) and for UK students will provide funding for tuition fees and a maintenance grant at the standard UKRI rate, currently £15,609 for the 2022/23 academic year. Funding may be available on a competitive basis to exceptional students of any citizenship. Applications are welcome to those able to support themselves or with funding already arranged. Such applications will go through the same level of academic assessment. For further details please contact Prof Julie Macpherson (j.macpherson@warwick.ac.uk) and DST.Admin@warwick.ac.uk, and provide a CV.

Further information about the research of Prof. Macpherson can be found at: https://warwick.ac.uk/fac/sci/chemistry/staff/juliemacpherson/. The Warwick Electrochemistry and Interfaces Group are internationally renowned, offering an excellent research environment with world class facilities dedicated to electrochemical and interfacial research, see: https://warwick.ac.uk/fac/sci/chemistry/research/unwin/electrochemistry/