



Diamond-based beta-voltaics: an ultra-long life energy solution for use in challenging environments

PhD EPSRC 'CASE' Studentship

Supported by BAE Systems (Maritime), Submarines Division

Applications are invited for a fully funded EPSRC Industrial CASE PhD Studentship to work with Professor Richard B. Jackman, Head of the Diamond Electronics Group (DEG) (London Centre for Nanotechnology (LCN), Department of Electronic and Electrical Engineering, UCL) on Diamond-based beta-voltaics. The studentship is supported by the Engineering and Physical Sciences Research Council (EPSRC) and BAE Systems (Maritime).



The studentship will cover Home/EU tuition fees and an annual stipend of no less than £16,777, increasing annually with inflation. The studentship is funded for 4 years on a full-time basis.

Studentship Details

There has never been a time when small, environmentally robust, power supplies have been needed more; many systems require power supplies that are both long lasting and maintenance free batteries. The proposed project offers a radiation resilient, thermally stable (>250C), rugged low power battery that has a lifetime of up to 20 years without the need for recharging. It is environmentally safe, with harmless by-products once exhausted. The internet-of-things means that sensors and security devices can be remotely deployed and communicated with, provided they have a suitable power supply. The diamond-based beta-voltaic solution offered by this PhD programme could be deployed in the ocean, land or space. Beta-voltaic devices generate current and are in effect a form of battery, which use energy from a radioactive source emitting beta-particles (electrons). Tritium, a form of hydrogen, emits energetic electrons (betas) that can be used to turn on a diode device – with a half-life of 12.5 years, ultra-long life batteries can be envisaged. Betas are stopped by a sheet of paper, so represent little in the way of a harmful threat to the environment.

Known to most as a gemstone, Diamond is actually a semiconductor material, with electronic properties that far surpass those of conventional electronic materials such as silicon. Diamonds extreme resilience towards hostile environments, including high radiation and high temperatures make it an ideal platform for the fabrication of electronic devices for use in applications where other semiconductor devices simply fail. The recent emergence of laboratory grown diamond, and methods for doping and processing diamond for device applications provide the entry point for this PhD programme. The proposed PhD project aims to ally the capability of diamond to absorb, and maintain in a stable form, tritium as a beta source, with a diamond diode structure for what can be anticipated to be a high efficiency ultra-stable beta-voltaic device for use in many environments that conventional battery technology cannot address.

UCL (University College London) is London's leading multidisciplinary university, with more than 13,000 staff and 38,000 students from 150 different countries. Founded in 1826 in the heart of London, UCL was the first university in England to welcome students of any religion and the first to welcome women on equal terms with men. BAE Systems (Maritime) has key interests in emerging and game changing technologies that will influence future designs of naval ships and submarines. BAE Systems plc is a FTSE 100 UK-based multinational company.

Based at the London Centre for Nanotechnology in Bloomsbury, the studentship will be jointly supervised by Prof Jackman (UCL) and Dr Duncan Scott (BAES). The student will work closely with both Richard Jackman's research group at LCN and collaborators at BAES in Barrow-in-Furness.

Eligibility

The successful applicant should have or expect to achieve a degree (1st or 2:1) in a relevant subject, e.g. Electronic/General Engineering, Physics, Materials Science or similar.

Applicants must meet the EPSRC eligibility conditions to be eligible for the award – in summary this typically means that applicants must have no restrictions on their right to live in the UK permanently and have been resident in the UK for three years immediately prior to the studentship commencing. EU Citizens who have not been residing in the UK for the past 3 years may be eligible for a fees only award. Please see EPSRC's website for further details:

<https://www.epsrc.ac.uk/skills/students/help/eligibility/>

Apply

Interested candidates should contact Prof Richard Jackman (r.jackman@ucl.ac.uk) with a covering letter and a full CV (including contact details for at least two academic referees plus marks/grades achieved on current courses if/as applicable). The covering letter should outline your interest in and suitability for, researching the suggested topic.

This studentship is available to start from 1st March 2019 at the earliest and by 23rd September 2019 at the latest.