Solid-State Diamond Electron Devices

The electronics industry is dominated by the silicon-based devices, with compound materials favoured for optoelectronics such as light-emitting diodes and lasers. However, the advantages of these materials evaporate when one seeks to establish electron-devices with high electric fields and high current densities, and one needs to find viable alternatives.

Diamond's intrinsic properties are immediately striking, with an ability to not only provide a highly desirable basis for the movement of electrons (pseudo vacuum-like charge transport), but also to deal with the potentially formidable thermal challenges due to its very high thermal conductivity. Diamond is, however, not without challenges in terms of the realisation of electron devices.

The well-known hardness of the material correlates with the underlying chemical inertness of carbon in this form, which makes the standard semiconductor processing steps either inefficient or completely invalid. Research and development for exploitation of diamond in technology therefore involves technical challenges and opportunities at a number of levels, including the material at a very fundamental level, its subsequent modification (such as forming electrical contacts and chemical modification to change the electrical conductivity), the design and building of prototype devices, and the underpinning physics theory and modelling required to optimise and understand the operation of diamond-based electron devices.

This PhD project is jointly run by the School of Engineering in Newcastle University and eVInce Technology Ltd. The problem addresses a common problem for all wide-bandgap devices, but one that is acutely so for diamond, which is the creation of accurate device models that mirror actual measured performance. The PhD will involve a balance of development of advanced physical device models using the COMSOL software pack (in conjunction with other research based software packages), exploration of the underpinning theory coupled with development of practical laboratory skills for characterisation of materials, fabrication of the devices and their subsequent evaluation and validation against models.

Within Newcastle, the project will be jointly supervised by Prof Nick Wright for the laboratory aspects of the project and Dr Jon Goss for the modelling and theory, and co-ordinated with supervisory support, practical on-site device and/or test piece fabrication and characterisation with eVInce Technology at their facilities in Sedgefield.

Applications from a candidate from a Physics, Chemistry, Engineering or related background are encouraged, and for further details please contact Jon Goss: j.p.goss@newcastle.ac.uk.