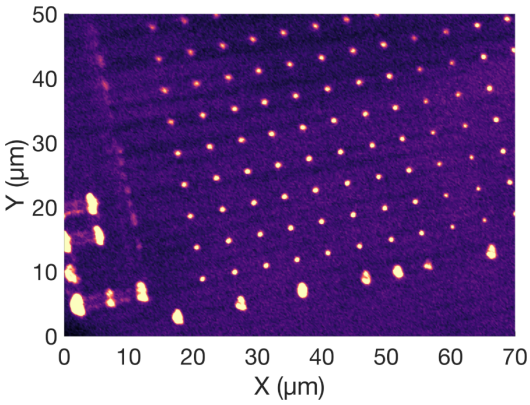
ENGINEERED DIAMOND TECHNOLOGIES PROSPERITY PARTNERSHIP

Optimised colour centre control for diamond quantum technologies

Supervisor: Dr Ben Green (Warwick Physics)
Second supervisor: Dr Gavin Morley (Warwick Physics)
Funding: Fully funded PhD studentship (48 months).
Start date: September/October 2022.
Application deadline: Ongoing

The development and implementation of quantum communication networks enables the possibility of deterministically secure links between remote nodes and is a necessary step in the realization of distributed quantum computing. Functionally, this boils down to the ability to transmit quantum states across a network.

Unfortunately, no network is lossless and therefore we must have some way of "refreshing" the information as it traverses the network. In a classical telecoms network, this is handled by an amplifier, which detects, amplifies, and re-transmits the optical signal. In a quantum network we must preserve quantum information, not just classical, and the analogue of an amplifier is known as a "quantum repeater".



Diamond is an ideal host crystal for a functional quantum repeater due to its superlative optical and thermal properties. Impurities introduced into the crystal can be thought of as "trapped molecules" with associated optical and spin properties. However, the realisation of real-world diamond-based quantum technologies requires advances in materials synthesis, defect production, and defect control. This project will design, fabricate, and characterise active control and readout systems for diamond quantum technologies using novel and established colour centres.

The project will involve but is not limited to:

- the design and fabrication of active devices designed to probe and control the properties of individual and small ensembles of novel colour centres in diamond at room and cryogenic temperatures
- investigation into the fundamental properties of novel and established colour centres using the control devices
- exploitation of novel, low-strain material developed within the Engineered Diamond Technologies project
- development of experimental results into the foundations of an engineered quantum technology, including input into the production of prototype "technology demonstrator" devices in close collaboration with the wider Engineered Diamond Technologies collaboration

The research will be carried out in both the Physics and Engineering Departments at 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 defect and material characterisation, and micro/nanofabrication of devices based on diamond. 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.

Applicants must have (or expect to obtain) at least the equivalent of a UK first or upper second-class degree in Physics (or related subjects). The studentship will commence in October 2022 (although an earlier start is possible based on your availability) and will provide a maintenance grant and tuition fees at the standard UK rate, currently set at £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 Dr Ben Green (b.green@warwick.ac.uk) and DST.Admin@warwick.ac.uk, along with a CV. Further information about the research of Dr. Green can be found at https://go.warwick.ac.uk/bgreen.