Dowthwaite MScR Scholarship 2023/24 entry

DEPARTMENT OF PHYSICS

Principal Supervisor: Del Atkinson

Other Supervisors: Adekunle Adeyeye

Project Title/Theme: Spintronic materials physics for low-power flexible electronics

Project Description

Flexible electronics is an exciting and rapidly growing field encompassing a wide range of technologies and applications that spans current consumer applications, such as flexible displays, through to demonstrators and concepts, including sensing textiles and 'electronic skin'. Flexible thin-film integrated circuits hosted on polymeric substrates offer lightweight, rugged electronic circuits for low-cost integration into a wide range of products, creating new uses, adding benefits from embedded electronic functionality and providing technology for the 'Internet of Things'. These circuits need memory and sensors for which spintronics can provide some answers.

Spintronics describes the physics occurring in thin-film, nanometre-scale magnetic systems that involves the flow of current in the device where the current flow is controlled by the magnetization state of the magnetic layers in the spintronic system. This magnetization-dependent electrical behaviour can then be used for sensing applications or in magnetic memory for electronics technology. Spintronics on rigid substrates is widely used for sensors and is critical in the modern hard-disk drive that underpins the data storage in cloud computing and solid-state spintronic memory is already used in robust memory chips called MRAM (magnetic random access memory), which have been highlighted by the International Technology Roadmap for Semiconductors (ITRS) as the most promising of a range of emerging memory technologies. Spintronics is also widely used in magnetic field-based sensors for applications in technology and typically involves many ultra-thin layers of magnetic and non-magnetic materials, which is technically challenging and very costly.

Spintronics would be highly beneficial for many of the low-cost and low-power applications targeted by flexible electronics. However, the production processes for flexible electronics impose significantly constraints on spintronic device fabrication, such as larger device features, rougher substrate surfaces and the need for much fewer and thicker magnetic films than in conventional spintronics. Nevertheless, the international R&D focus on conventional, high-end spintronics provides an exceptional knowledge-base on which to build this exciting project on spintronics integrated flexible electronics. For the application of spintronics in flexible electronics we need to demonstrate functional sensor or memory behaviour in thin-films.

This project will explore the development magnetic memory functionality within a minimal two-layer system grown on flexible substrate. The work will be based on the anomalous Hall effect and involve work to develop enhanced (low power) spin-orbit torque (SOT) switching. This experimental project will involve the growth of spintronic thin-films, structural analysis

using x-rays and static and dynamic magnetisation measurements. This work may also lead to the publication of a research paper.

How to apply
You must apply through the University's applicant portal

You will need to:

- State 'CMP and Spintronic materials physics for low-power flexible electronics in the 'Field of Study' section.
- On the funding tab select 'yes' you are applying for a scholarship, select 'Other' write DOW232 in the name of the scholarship, and select 1st October 2023 as the start date
- attach a covering letter and CV
- attach degree transcripts and certificates and, if English is not your first language, a copy of your English language qualifications.
- provide 2 referee contact details (specifically email addresses) who we will contact directly.

Contact
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