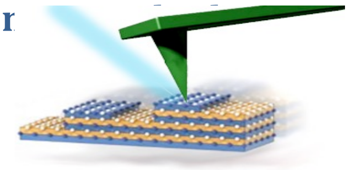
Ferroelectric field effect transistors for next generation memories and cognitive computing



Functional Materials Group

Perovskite oxides are a family of materials that display an incredible diversity of physical phenomena including high-temperature superconductivity, colossal magnetoresistance, magnetism, ferroelectricity, etc. By using state-of-the-art deposition techniques, artificially layered epitaxial heterostructures can be created enabling the properties of individual oxides to be combined into new multifunctional materials. Moreover, complex interactions between the electronic, magnetic and structural degrees of freedom arising at interfaces in these nanostructured materials often lead to the emergence of new properties that can be drastically different from those of the parent compounds, opening almost endless possibilities for engineering of new functionalities.

Of particular interest for this project, strong electric fields can be formed at the surface of thin-film ferroelectric perovskite oxides, with the field patterned with nanoscale precision and with rapid dynamic response. This presents an exciting opportunity to create agile electronics by combining perovskite ferroelectrics with two-dimensional materials (2DMs) whose electronic properties are highly sensitive to electric fields. Creating a robust platform for electrostatically defining insulating and conducting regions in 2DMs, and for dynamically switching their conductivity, will allow us to explore new physical phenomena and develop new electronic functionalities.

The aim of this project is to explore new artificial heterostructure systems that combine ultrathin ferroelectrics with other types of materials, especially 2D van-der-Waals semiconductors, exploiting reduced dimensionality and interfacial interactions to control the properties and engineer new functionalities in these artificial materials.

The work will involve: growth of high quality epitaxial thin films of oxide functional materials by pulsed laser deposition (PLD); and basic characterization which will include structural, ferroelectric and semiconductor measurements. Macroscopic and local properties will be investigated using existing state-of-the-art characterization methods. A major part of the effort will be allocated to integrate the ferroelectric layers with 2D semiconductors in order to fabricate ferroelectric field effect transistors for next generation non-volatile memories and cognitive computing. The successful applicant will work as part of a team of researchers in this area at the University of Warwick, attached to a funded research project.

Professional duties and responsibilities:

- Epitaxial film growth and characterisation using pulsed laser deposition and a broad range of experimental techniques including laboratory X-ray diffraction, dielectric impedance spectroscopy, atomic force microscopy, transport and magnetic measurements.
- Performing data analysis and modelling the results.
- Preparing manuscripts for publication in peer-reviewed journals.

- Participating in local seminars as well as national and international conferences.
- Contributing to the overall activities of the research team and the department.
- Interacting with national and international collaborators.

Personal qualifications and skills

- This position is only open to UK citizens or EU citizens settled in the UK due to funding restrictions. Applicants should have, or expect to be awarded, an undergraduate degree in Physics or a related discipline at a level of 2.1 or above.
- Good understanding and interest in condensed matter and/or materials physics.
- Strong analytical thinking and creative problem-solving skills.
- Ability to take initiative and to work independently and responsibly.
- Good team-working skills.
- Fluency and clarity in spoken English; good written English.

To discuss this project further contact:

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