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| **Summer Placement Project Proposal** |
| Supervisor(s): Dr Thorsten Hesjedal  Nominees in case of absence: Dr Yulin Chen, Mr Piet Schoenherr  Duration of Placement: 12 weeks  Date restrictions: none |
| **Section 1: Project description:**  Project title: **Synthesis of topological insulator nanostructures**  The project aims at synthesising topological insulator (TI) nanostructures by novel catalytic routes using chemical vapour deposition and molecular beam epitaxy. The student will join a team of engaged researchers involved with all aspects of TI research.  Topological insulators are a very exciting new class of quantum materials that is insulating in its bulk and conducting on its surface. The exotic metallic surface state is topologically protected by time-reversal symmetry against a number of scattering effects. As a result, the novel phases of matter that have been known since the discovery of the fractional quantum Hall effect seem now to be in reach for room-temperature spintronic and quantum computing device applications.  Recently, we have shown that TI nanostructures can be grown using a novel catalyst which does not leave traces of itself in the growing nanostructure. This project builds on these recent breakthroughs by systematically studying binary and ternary catalyst systems with the aim of achieving selected area growth, particularly through the manipulation of the chemical binding agent.  This exploratory materials synthesis project uses chemical vapour deposition (CVD) and molecular beam epitaxy (MBE) for the materials synthesis. MBE is a superior tool for the precise engineering of quantum materials – in the form of thin films, nanowires, or self-assembled quantum dots. For the characterisation of the materials, scanning electron microscopy (SEM w/ EDS), transmission electron microscopy (TEM), atomic force microscopy (AFM), x-ray diffraction and reflectometry (XRD/XRR) will be applied (training for all tools will be provided). The work will be carried out in Oxford’s Thin Film Quantum Materials Laboratory in the RCaH (http://www.rc-harwell.ac.uk/) at the Rutherford Appleton Laboratory. |
| **Section 4: Special requirements (skills and experience required):**  Required skills: practical lab experience, strong interest in materials  Desired skills: electron microscopy; scanning probe microscopy; ultra-high vacuum technology a plus, but not a must; basic knowledge of electronics and programming (e.g. Python) |