Heteroepitaxy of silicon carbide on silicon using novel strain platforms

Supervisor: Maksym Myronov
NanoSilicon Group, Physics, University of Warwick

Silicon carbide (SiC) is a wide bandgap semiconductor material attractive for high power and high frequency electronic devices, due to its excellent properties (high thermal conductivity, breakdown field and saturation velocity). SiC has numerous polytypes with different crystal structures, among which 4H- and 6H-SiC are routinely used to fabricate electronic devices. 4H and 6H-SiC films of good crystal quality can be obtained by homoepitaxy on SiC substrates, which are expensive. This project will establish and unlock the potential of a recently invented technology at Warwick that uses an alternative polytype, 3C-SiC, which can be grown heteroepitaxially on silicon (111) surfaces. High quality 3C-SiC on Si(111) provides an ideal strain tuning platform for the subsequent growth of GaN heterostructures, and the long-awaited realization of low-cost mass produced LEDs, HEMTs and a variety of high power electronic devices. Further, 3C-SiC can act as a substrate for the epitaxial growth of novel heterostructures of 2D materials, including graphene.

The project is an exciting opportunity to be involved in research and development of new concepts in 3C-SiC heteroepitaxial growth. Structural and electronic material and devices properties will be researched by a variety of in-house cutting edge experimental techniques including: Hall effect and resistivity, transmission electron microscopy (TEM), atomic force microscopy (AFM), scanning electron microscopy (SEM), Fourier Transfer Infrared Spectroscopy (FTIR), PL, Raman spectroscopy and X-ray diffraction.

A complete characterization of these new epitaxial materials will provide an in-depth analysis and understanding of 3C-SiC heteroepitaxy, materials and devices made from this material. The project will involve collaboration with world's leading semiconductor companies involved in production and development of GaN epitaxial materials and devices, as well as with scientists from national and international universities, and a spin-out company from the University of Warwick. The project will lead to high impact publications in international scientific journals, and to the application of developed materials in a variety of electronic and photonic devices using the capabilities of our industrial collaborators.

Informal enquiries may be directed to Dr. Maksym Myronov (M.Myronov@warwick.ac.uk). This 3.5 year studentship is available for UK or outstanding EU students.

The student will be enrolled on the Materials Physics Doctorate scheme (go.warwick.ac.uk/MPDOC). This gives access to a tailored research degree to exploit Warwick's outstanding materials growth, fabrication, characterisation and computational capabilities, and those at central facilities. A broad education in Materials Physics is provided through dedicated modules under the Midlands Physics Alliance Graduate School, and external courses.