**Title**

**Strained Silicon Germanium heterostructures for high efficiency thermoelectric devices**

**Description**

Thermoelectric materials generate electricity from a temperature difference using the Seebeck effect. The generation efficiency (characterised by the parameter ZT) requires a material with high electronic conductivity and low thermal conductivity. At present, most thermoelectric devices are based on bulk material properties, limiting the ZT, in part due to the Wiedemann-Franz Law which linearly relates the electrical and thermal conductivities for heavily doped, metallic semiconductors. Significantly higher ZTs can be obtained for low-dimensional semiconductor structures using quantum wells, wires or dots. In order to produce practical devices, however, it is necessary for a large number of these quantum well layers to be considered. Ge has a larger lattice constant than Si, which introduces strain and a critical thickness for each layer of a thermoelectric designs using SiGe heterostructures, as well as the complete stack of strained layers. As all practical thermoelectric generator designs would be significantly greater than the critical thickness, strained balanced quantum well structures must be created by adjusting the lattice parameter of the starting “virtual substrate”.

The project will explore novel designs of high Ge content, strain balanced, multilayered SiGe heterostructures with a very large number of periods, above 1000. The thickness of the individual SiGe epilayers will be varied from few monolayers up to several nanometers. Thus precise control of the epilayer thickness, Ge and dopant content, and their reproducibility across 1000’s of periods will be essential. Epitaxial growth of the structures will be developed in-house using industrial class Reduced Pressure Chemical Vapor Deposition equipment. Materials properties will be assessed by a variety of in-house cutting edge experimental techniques including conductivity and thermoelectric measurements, Transmission Elecron Microscopy, Atomic Force Microscopy, Scanning Electron Microscopy and X-ray diffraction. Thermoelectric devices will be fabricated and characterized in collaboration with national and international research partners using state of the art technologies and techniques. A successful outcome from the project could lead to the materials developed being application in practical power generators.

This PhD studentship is available for an immediate start. To discuss this project further contact: Dr Maksym Myronov (M.Myronov@warwick.ac.uk) and Professor David R. Leadley (d.r.leadley@warwick.ac.uk)