FindAPhD Project Template

Department Name: Department of Electrical Engineering and Electronics, Department of Physics

Supervisor(s) and their email address (2 max): Dr Ian Sandall, Ian.sandall@liverpool.ac.uk and Dr Tim Veal, T.Veal@liverpool.ac.uk

Funding Status (select from below drop down menu):

Directly Funded Project (Students Worldwide)

Application Deadline: 31/09/2018

Project Title: Electrical and Optical properties of mid infrared optoelectronic devices containing gallium antimonide-based highly mismatched alloys
Semiconductors are the cornerstone of modern electronic and optoelectronic devices. A given device often requires a specific energy band gap, or a junction of two or more semiconductors, furthermore to form efficient devices the differing semiconductors require a similar lattice constant. Control and optimisation of the band gap and lattice constant of materials is therefore of crucial importance. The most common way to change these properties is to alloy binary semiconductors. The band gap of the alloy varies between the band gaps of the two binary compounds, normally with only limited deviation from a linear variation. However, it has been discovered [1] that incorporating a small concentration of N within a III-V semiconductor such as GaAs or InSb leads to a drastic reduction of the band gap, and a large ‘bowing’ away from a linear band gap variation.

Observations of such behaviour have also been made for GaN,Sb, [2] and GaSb, Bi, alloys [3]. These materials have tremendous potential for a variety of applications as only small deviations in the lattice constant can result in dramatic changes in optical and electrical properties. They can potentially be used for thermophotovoltaics (generation of electricity from heat sources) as well as light emitting diodes in the 2-5 µm range for detection of gases such as CH₄, CO₂ and CO. However, a critical aspect of the study of these alloys is to establish the relationship between growth conditions, optical properties, alloy composition and electrical properties.

The focus of this project will be to fabricate and characterize (both electrically and optically) semiconductor devices containing GaSbBi and GaSbN layers. Characterisation techniques that will be used include; Electron Microscopy, X-Ray Diffraction, Optical Absorption, Current-Voltage and Capacitance-Voltage measurements. A range of different devices will be studied including thin epitaxial layers (as Schottky Diodes) and heterojunctions containing quantum wells of GaSbBi(N) as potential use as mid infrared emitters and detectors. The successful candidate will also undertake numerical simulation and modelling to validate the experimental results.


Supervisor websites: https://www.liverpool.ac.uk/electrical-engineering-and-electronics/staff/ian-sandall/
Applications from UK, EU and overseas/international self-funded students are welcome.
Scholarship providing payment of fees and living expenses available to UK/EU applicants

Enquiries should be addressed to Dr Ian Sandall (Ian.Sandall@liverpool.ac.uk) or Dr. Tim Veal (T.Veal@Liverpool.ac.uk)
Engineering
- Acoustics
- Aeronautical Engineering
- Biomedical Engineering
- Chemical Engineering
- Civil & Structural Engineering
- Electrical & Electronic Engineering
- Energy
- Manufacturing
- Materials Science
- Mechanical Engineering
- Nanotechnology
- Nuclear Engineering
- Semiconductors
- Software Engineering
- Telecommunications

Maths & Computing
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- Bioinformatics
- Computational Chemistry
- Computer Science & IT
- Data Analysis
- Information Science
- Mathematics
- Operational Research
- Software Engineering
- Statistics

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- Archaeology
- Architecture & the Built Environment
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- Communication, Cultural & Media Studies
- European Studies
- Geography
History
Middle East & African Studies
Modern Languages & Linguistics
Philosophy
Theology & Religious Studies

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American Studies
Anthropology
Architecture & the Built Environment
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Philosophy
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Sports, Recreation & Leisure Studies
Social Work, Social Policy & Administration

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- Biophysics
- Biotechnology
- Botany / Plant Science
- Cancer / Oncology
- Cell Biology / Development
- Dentistry
- Ecology & Conservation
- Endocrinology
- Evolution
- Food Science / Nutrition
- Genetics
- Immunology
- Marine Biology
- Medical / Biomedical Physics
- Medical / Clinical Science
- Microbiology
- Molecular Biology
- Neuroscience / Neurology
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- Parasitology
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- Pharmacology / Toxicology
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- Psychology & Psychiatry
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- Veterinary Medicine
- Virology
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- Agricultural Chemistry

Law
- Law

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- Particle Physics
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- Theoretical Physics
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- Ecology & Conservation
- Ecotoxicology & Pollution
- Environmental Chemistry
- Environmental Science
- Geochemistry
- Geography
- Geology
- Geophysics
- Hydrology
- Meteorology
- Oceanography