Micro and Nanotechnology (MNT) for Sensor Development

Academic Directory

Edition 1.0
Introduction

This directory has been produced by the Knowledge Transfer Network (KTN) as an update to a guide produced by the Micro and Nano Sensors Interest Group in 2009.

Micro and nano technology has continued to receive significant attention over the past decade as it enables the development of high performance, low energy-consuming novel sensors. The availability of new types of tools and techniques and the ability to develop new materials with unique properties has facilitated the development of such sensors. Considering the importance of micro and nano technology to the sensors and instrumentation industry, and the strength of UK academic research in this area this guide has been produced to enable members of industry to locate potential academic partners.

This directory aims to cover the breadth of academic activity in this area, however it has not been possible to make contact with all of the universities listed in the previous guide. Therefore if you think that the activities of a particular university have not been included please contact felicity.carlysle@ktn-uk.org so that those details can be included in the next edition of the directory.

The sensors and instrumentation community within the KTN runs a programme of events throughout the year, for further information please visit:

https://connect.innovateuk.org/web/sensors-and-instrumentation
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Surface Engineering and Nanotechnology Institute (SENTi)


Description

The Surface Engineering and Nanotechnology Institute (SENTi) is a world-leading Centre of excellence for innovative research into atomistic and particulate based manufacturing techniques for the production of protective and active surface coating systems with a mission to transform innovative manufacturing research into engineered products. The Institute is led by Professor John Nicholls.

The Institute works closely with industry, non-government organisations and government agencies to foster the use of coating systems and surface engineering as part of high-value manufacturing and operates across a range of sectors, including aerospace, automotive, oil and gas, biomedical and mining with our client base varying from large multinational companies such as Rolls-Royce and Siemens to SMEs and micro-companies.

SENTi fosters and accelerates development of emerging high value products through fundamental, strategic and applied research from the nanotechnology scale through to prototype component manufacture and integrates this knowledge base into related postgraduate studies.

Point of Contact

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Facilities

The Surface Engineering and Nanotechnology Institute (SENTi) performs world-class research and technological development through engagement with industry. It provides the critical mass of research staff and coating technologies to develop new surface engineering technologies, methods and practice through to prototype component manufacture. The Institute maintains a close relationship with industry through engagement with the OEMs and their supply chains. This ensures that the research carried out, whether at a
fundamental, strategic or applied level, is of direct relevance to both industry and academia and demonstrates best surface engineering practice.

The extensive research facilities are incorporated in two Centres of Excellence within SENTi:

• The National High Temperature Surface Engineering Centre (NHTSEC)

The Centre has established a worldwide reputation for its expertise in designing, testing and analysing coatings/surface treatments, especially for components subjected to extreme and hostile environments. The NHTSEC is a unique university centre in that it is 82% funded directly from industrially related contracts and is the only university centre worldwide that can deposit coatings that go directly into Rolls-Royce UK test engines. The Centre has experience and expertise in a range of coating techniques and can be called upon for surface engineering solutions from design of coatings through production, analysis and testing to lifeing of coating systems.

• Cranfield Nano

A founding member of the Piezo Institute undertaking nanofabrication and nanotechnology research. The gateway to engage with nanotechnology expertise at Cranfield and offers a proven track record of nanotechnology research. Research activities range from the development of new functional nanomaterials through to biosensors and atomistic simulation of nanostructures, encompassing such diverse areas as materials science, medicine, biology, physics and chemistry with applications in a broad range of industrial sectors; as diverse as aerospace, automotive, defence, energy, environment, healthcare, management, manufacturing and security.

The Institute’s world-class facilities include clean rooms, laboratories and test/fabrication services through to prototype component manufacture, with extensive analysis, modelling, synthesis and characterisation capability. We offer Surface Engineering Solutions that aDAPT to your needs (Design, Analysis, Production, Testing) within the theme of ‘Design for Process Excellence’.

**Current Research**

Since the Centre's inception, an important line of research has been aimed at developing a range of micro electronic and electro-mechanical devices for sensing, actuation and information processing and storage, making especial use of ferroelectric thin and thick films in microengineered structures.; micro solid oxide fuel cells (iSOFC); and the capture, analysis and representation of knowledge, especially in relation to the design of nanomaterials, nanostructures and nanodevices. A detailed list of current projects and opportunities can be found from their website.
Imperial College, University of London
The Optical and Semiconductor Devices Group

http://www3.imperial.ac.uk/opticalandsemidev/aboutthegroup

Description

This is a large and active group with several sensor-related projects underway. They have established links with industrial partners in UK and internationally. Its research interests are broad and multi-disciplinary. Much of its work is concerned with the development of micro electro-mechanical systems, optical devices, low power and microwave devices and circuits, but there is also a strong interest in the supporting materials technology and device physics.

Point of Contact

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Facilities

The Group has three well-equipped clean rooms, in which the majority of device fabrication takes place. Other labs house equipment for thin film, electrical, optical and mechanical characterisation, and also computing and CAD facilities, as described below:

- Annealing and Oxidation
- Metallisation and Sputtering
- Metrology and Characterization
- Photolithography
- Plasma Etching
- Wafer Bonding and Sawing
- Wet Benches
- Device Modelling and CAD Laboratory

Current Research

The group has two areas of focus;

Microsystems - including micro electrical devices, micro optical devices, micro mechanical devices, MEMS fabrication.
Newcastle University

nanoLAB: University Research Centre for Nanoscience and Technology

http://www.ncl.ac.uk/nanolab

Description

There are more than 80 nanoLAB staff and student members from across all three faculties at Newcastle University with research interests ranging from fundamental nanoscience, through mechanical and medical applications to ethical issues. The EPSRC XPS facility is located within nanoLAB.

Point of Contact

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Facilities

Fabrication facilities include two class 100-10000 clean rooms:

L1 clean room - New class 100-10000 clean room houses a 200mm cluster tool for ALD and sputter deposition and an RTP furnace

L4 clean room - Class 100-10000 clean room specialising in SiC device processing and interconnection research.

- EMS 5000 Spin Coater
- SLEE Co. Mask Aligner
- Karl Suss MJB-3 Aligner; Minimum feature size: 1.5 µm; Alignment accuracy +/- 1 µm (front side align)
- Hotplate and oven baking
- Lift-off process (image reversal)
- Spin coating of photoresists and polyimides
- Wet Processing
- Two class 100 vertical laminar flow work stations with extraction. Both stations are equipped with Ultrasonic baths; The Veolia Water Systems Ltd. PURELAB Ultra source of ultrapure water; Chemically resistant hot plates; Nitrogen jets.
- Picosun R-200 Advanced plasma Atomic Layer Deposition tool
- Oxford Instruments FlexAL 200mm Atomic Layer Deposition tool
- Oxford Instruments Plasmalab System 400 DC & RF magnetron sputter tool (equipped with 4 inch RF and two 8 inch DC magnetrons for metals and dielectrics sputtering)
- Two individual Kurt J. Lesker PVD 75 vacuum deposition systems. Each sputter deposition system contains two targets for magnetron sputtering (one machine is fitted with two DC power sources and the second machine has one DC and one RF/DC power source)
- BOC-Edwards Auto thermal evaporator fitted with four evaporation boats
- BOC-Edwards Auto e-beam evaporator fitted with four hearth crucible deposition of wide range of materials including refractory metals
- JetFirst 200 bench top RTP processor (at temperatures up to 1200°C in high vacuum, nitrogen, oxygen, ammonia and forming gas)
- JIPELEC rapid thermal processing furnace specified for SiC post-implantation annealing (at temperatures up to 2000°C in argon and nitrogen)
- Two custom made oxidation furnaces (oxidation in nitric oxide, dry and wet oxygen).
- Plasma-Therm 790 series RIE machine (silicon, silicon carbide, silicon dioxide, polysilicon, polyimide, etc. using SF6, CHF3, O2, Ar gases and mixtures, resist stripping and de-scum)
- TEGAL Co. PLASMOD microwave asher
- TCB-21e Dage Precima Bonder
- Carl Zeiss Interference Microscope
- Leitz Wetzlar Optical Microscope
- Tencor P-1 Long Scan Profiler
- KSV Instruments CAM-100 Contact Angle Meter
- Filmmetrics F40 Thin Film Thickness Measurement System
- Probe station with Tektronix 577 curve tracer
- In addition to its own facilities, the Group has access to a 400 m2 class 100 cleanroom for device fabrication, packaging and evaluation at the INEX - a contract development, manufacturing and commercialisation centre for specialist electronic devices, microsystems and nanotechnology based at Newcastle University. Material characterization facilities:

XPS has online remote access capability and has been used throughout UK, rest of EU, Australia, Singapore.

Training on equipment, analysis, interpretation and quantification are available. State of art XPS spectrometers include (i) AXIS Nova (Kratos Analytical); (ii) K-Alpha (Thermo Scientific) (iii) Theta Probe (Thermo Scientific). Graphene (and nanomaterial) characterisation tool, includes an Omicron nanolab 4-probe UHV STM system and allows simultaneous electrical
measurements, SEM, Auger and XPS. AFM: XE-150 AFM (Park) with: Vacuum chuck for 6 in wafers; Magnetic chuck for small samples.

Capabilities: contact, non-contact, conductive, capacitance, electrostatic force, piezo, magnetic force AFM.

Raman: LabRAM HP confocal Raman microscope fitted with: Tunable Argon ion laser: 457, 588, 514 nm (including edge filter sets for these wavelengths); Gratings: 2400 and 3000 g/mm

XRD: Bruker D8 Advance X-ray Diffractometer system (GIXRD and XRF capable).

He – Ion Microscope: Zeiss-Orion nanoFab. Imagining ~ 0.5 nm lateral resolution; ~ mm depth of field

Electrical characterization platform:

(i) Low Frequency I-V, C-V, Polarization-Field (P-E) characterisation: Probe stations; LCR Meter; Semiconductor Analyser; Precision Premier II 10V Ferroelectric Test System

(ii) High temperature/high voltage probing station: T control Heater; picoammeter; HV power source

(iii) High Frequency characterization (< 67 GHz): Probe Stations; Spectrum analyser; Microwave vector analyser; PSA Spectrum analyser; Network analyser;

(iv) Electrical Noise characterisation: Probe Stations; Noise Figure Analyser 10MHz-26.5GHz

Current Research

Typical funded projects include: Realization, understanding, integration and applications of ferroelectric thin films in nanoelectronics. In 2014 we demonstrated the first experimental evidence for effective negative capacitance in thin ferroelectric Barium Titanate. Combinations of atomic layer deposition and sputtering are being used to investigate the best contact materials for commercially relevant semiconductors. A novel method to achieve this is to insert a nm scale dielectric screening barrier between the metal and semiconductor. The metal electron wavefunction no longer reaches the semiconductor and so the Fermi level is unpinned. The barrier height can then be tuned by the choice of metal. We are designing multi-electrode EMG needles for rapid 2-dimensional imaging of motor unit morphology and stability without the need for needle movement. EMG measures electrical activity generated within skeletal muscle. We are developing an in-vivo opto-electrode technology using a closed loop control in order to prevent brain seizures initiating (e.g. control of epilepsy).
Nottingham Trent University
School of Science and Technology

http://www.ntu.ac.uk/research/school_research/sat/index.html

Description

Biomedical Sciences and, Devices and Materials are the two interdisciplinary research groups within the School. Within Biomedical Sciences the two main themes are Health and Disease (Tumour biology, Cell biology, ageing and pathology, Neurobiology, toxicology and pharmacology, and Pathogen research) and Enabling and Cross-cutting Technologies (Bioinformatics and biomathematics, Therapeutic chemistry, Proteomics and genomics). Within Devices and Materials the two themes are Imaging and Sensing (Security x-ray imaging, Magnetic resonance, relaxation and imaging, Advanced optical imaging, and Acoustics and vibrometry) and Bio-materials and Materials Engineering (Electronic and photonic materials, Solid/liquid interfacial science, Multi-functional materials synthesis and properties, and Bio-functional/derived/inspired materials).

Point of Contact

Professor Carl Brown

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Facilities

Laboratories are well equipped with:

- 3-D real-time X-ray imaging set
- X-ray diffractometers (Philips X’Pert Pro powder, Oxford Diffraction Single Crystal)
- Magnetic resonance (Bruker MRI, 2.35 T, 72 mm; Portable NMR-MOUSE (ACT); Halbach MRI ACT, 0.5 T, 40 mm)
- 3D sub-surface imager (Thorlabs SROCT)
- Mach-Zehnder phase imager supercontinuum Laser
- X-Ray Fluorescence Spectrometers
- Electron microscopy (JEOL JEM-2010, JSM-840A with x-ray)
- Confocal microscopy (Leica SP-5, DM-RBE/IRBE)
- Fluorescence microscopy
- Lasers for thin film processing and photoluminescence (Excimer Lambda Physik 305i, Tunable NdYAG Surelite 3, HeCd CW, N2 20ns pulse)
• Profilometers (Veeco Wyko NT110 Optical, Dektak 6M Stylus)
• Spectrometers (Filmetrics Reflection)
• Optical tweezers
• Viscometers
• A high voltage laboratory
• Laminar flow water tunnel with PIV
• Krüss Drop Shape Analysis contact angle meter
• High speed video cameras (Hotspot, Megaspeed, Gigaview), MaxTex QCM
• A photo-lithography facility (Süss Microtech MJ84 mask aligner, thermal/sputter deposition and UV/Ozone)
• Facilities also include a comprehensive proteomic suite (2-D gel electrophoresis, mass spectrometry, and automated robotics), cell culture facilities, flow cytometry and macro-and micro-imaging equipment, plus the normal range of molecular, biochemical and analytical facilities.

Current Research

• Acoustic Wave Sensors: High frequency vibrations of quartz crystals microbalances (QCMs) are used to probe the solid-liquid and solid-vapour interfaces with selectivity achieved via surface coatings.
• Nanometre scale molecular capsules and tubes, capable of encapsulating and protecting a variety of guest molecules. They are designed with readily accessible surface modifiers incorporated into their structures to allow multi-component functionality.
• Nano-electrospray of nanomaterials and biomolecules for advanced functional coatings, patterned and precision surfaces.
• Novel nanoparticle antibiotic conjugates with high antimicrobial activity. Novel mineralised surfaces for functional transistors, biomaterials and cancer studies.
• Plasmonic thin films including developing optical coatings comprising hard wearing and long lasting dielectric thin films with metal nanoparticles of controlled size and density embedded in them.
• Laser Manipulation of Plasmonic Nanostructures.
• Magnetic resonance based sensors: low cost, robust and remotely deployable.
• Capillary flow in microstructured closed and open channels, inhibition of fluids into microstructured surfaces.
University College London
Department of Chemistry

http://www.chem.ucl.ac.uk/

Description

The Department of Chemistry is one of the top Chemistry departments in the UK with a 5** rating. It has international strengths in organic synthesis, chemical biology, computation chemistry, nanotechnology, inorganic and materials chemistry and physical chemistry and chemical physics.

Point of Contact

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Facilities

Visit: http://www.chem.ucl.ac.uk/research/facilities.html

Current Research

- Membrane protein pores: Engineering and single-molecule detection.
- DNA: Chemical tagging and single-molecule biophysics.
- S-layer proteins: Structural investigations and protein engineering.
- Solid substrates: Surface modification and applications for ultrasensitive sensing.
- Nanopores for single molecule detection. Dr Daren Caruana (d.j.caruana@ucl.ac.uk)
- Detection and quantification of bioaerosols for defence and healthcare applications. Professor Jawwad Darr (j.a.darr@ucl.ac.uk)
- Nanoparticles for gas sensing. Professor Ivan Parkin (i.p.parkin@ucl.ac.uk)
- Metal oxide gas sensors for detecting trace gases in air. Dr Stefan Howorka (s.howorka@ucl.ac.uk)
- Nanopore sensors for the electrical detection of analytes. Dr Chris Blackman (c.blackman@ucl.ac.uk)
- Miniature detectors for VOCs capable of quantitative measurement with low cross-sensitivity, humidity resistance, long life-span and poisoning resistance.
University of Birmingham

Micro-engineering and Nano-technology Research Group

http://www.micro-nano.bham.ac.uk/

Description

The Micro-Engineering and Nano-Technology Research Group is situated in the School of Mechanical Engineering at the University of Birmingham. It has cleanroom facilities for micro and nanofabrication of sensors and focuses on resonant mass sensors; fabrication of nanostructured surfaces for SPR, Metamaterial and diffractive & holographic sensing surfaces; as well as the fabrication of micromoulded components. It has strong links to the Schools of Chemistry & Chemical Engineering for development of chemically functionalised sensors.

Point of Contact

Dr Carl Anthony

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Facilities

The group has micro and nanofabrication facilities including:

- Silicon Deep Reactive Ion Etching
- FEI Dual beam FIB/FEG SEM
- Ebeam
- Optical lithography
- Wet chemical etching
- Thick SU8 processing
- Micro/nano electro forming
- Ceramic forming furnaces
- Wafer dicing and wire bonding.

As well as access to a suite of characterisation equipment: Alicona infinite focus microscope/ AFM/ nanoindentation/ interferometry/ ellipsometry/ tribometry. The group also has the state of the art polarisation optical microscope and optical characterisation equipment (goniometers) for nanophotonic device measurements.
Current Research

- The design and fabrication of resonant sensors
- Cantilever, fixed-fixed beam, micropaddle and double ended tuning fork resonant structures are being developed as resonant mass sensors. These are fabricated in either SOI through the use of DRIE or in SiN membranes using FIB prototyping.
- We are also working on suspended nanowire structures for sensing and ultrathin silicon for highly sensitive force sensing beams. Chemical functionalisation of these devices
- Focused ion beam nanofabrication using gallium implantation effects is being developed for rapid FIB direct patterning, allowing fast large area writing of nanoscale features
- FIB as a tool for Nanotomography of nanoporous materials, developing 3D models of the pore structure
- Design, fabrication and characterisation of nano-structured holographic/diffractive surfaces as well as micro/nano-optical devices
- Design and fabrication of micro/Nano-fluidic systems for blood extraction and separation; nanofilters and microneedle arrays
- Micro/nano electroforming of metallic structures and also Micromoulding of ceramic components
- Designing and simulations of graphene based metamaterials and ultra-thin diffractive devices
- Diffractive diffusers based on nanostructures and crystals such as devitrite
- Production of holographic surfaces and nanopatterns using laser interference assisted ablation.
University of Bradford
The Centre for Polymer and Micro Nano Technology (Polymer MNT)

http://www.bradford.ac.uk/research/rkt-centres/polymer-mnt/

Description

Polymer MNT can help customers develop new and improved micro and nano-components in a range of materials through: Access to state-of-the-art micro injection moulding equipment in our world leading research centre; Expertise to design bespoke processes: Materials preparation and characterisation. Process optimisation. Tool design. Product characterisation; Software expertise to develop sensing technology; Proof of concept and low volume manufacture. Key areas of expertise: Moulding of microscale features; Nano-structured surfaces; Nano fillers compounding and processing; Metal/ceramic powders; Materials characterisation and product measurement; Inspection/handling. For a number of applications: Medical devices, wound care, implants; Micro-optics; Sensors; Integrated micro devices.

Point of Contact

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Facilities

Visit http://www.bradford.ac.uk/research/rkt-centres/polymer-mnt/

Current Research

We are currently working with a number of commercial partners to develop innovative products for the following applications:

- Anti-counterfeit
- Surgical Tools/Implantable Devices
- Drug delivery
- Healthcare diagnostics
- Dentistry; Optics
- Mechanical components.
University of Durham

Department of Chemistry

http://www.dur.ac.uk/chemistry/

Description

Research in the Departments is focussed around six main groupings: Biological Chemistry, Materials; Synthesis and Structure, Optical and Molecular Electronics, Soft Matter; Surfaces and Interfaces, Sustainable Chemistry and Catalysis, Theory and Dynamics. In the area of nanotechnology, the focus is on the use of nanostructured materials for the development of new electronic devices, bio-sensors and high strength composites. The other areas of importance include the chemistry of carbon nanotubes and nanolithography (the patterning of surfaces). The group collaborates with Oxford, Cambridge and Nottingham.

Point of Contact

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Facilities

http://www.dur.ac.uk/chemistry/research/facilities/

Current Research

- Synthesis of new metal complexes that can be anchored to AFM tips
- Design and synthesis of molecular sensors for anions (e.g. environmental pollutants)
- Design of new organic precursors that are able to form self-assembled monolayers with exposed functional groups to allow site-specific catalytic surface reactions induced by the modified AFM tip
- Chemical functionalisation of carbon nanotubes to: a) Control their electronic properties for nanocircuitry b) Enhance their interaction with a range of polymer matrices to form new generation nanocomposites c) Improve and tailor the biocompatibility of the nanotube surface to selectively adsorb biological materials for nanoscale biosensors.
University of Edinburgh
Institute for Integrated Micro and Nano Systems (IMNS)

http://www.eng.ed.ac.uk/research/institutes/imns/contact-us

Description

The Institute for Integrated Micro and Nano Systems brings together researchers from integrated circuit design, system-on-chip design, microfabrication, micro-electro mechanical systems (MEMS), micro-machining and neural computation. The IMNS is a core partner of the Institute for Integrated Systems (IIS- http://www.erp.ac.uk/), one of five joint research institutes in the Edinburgh Research Partnership in Engineering and Mathematics (ERPEM). The core competencies of IIS include innovative, low-power VLSI design, novel computational paradigms, advanced silicon device fabrication, optical science and technology, photonics devices and systems (including sensors, lasers and displays), micro-electro-mechanical systems (MEMS), micro-machining, laser-based processing and ultrafast/nano-optics.

Point of Contact

Professor A.J. Walton

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E: Anthony.walton@ed.ac.uk

Facilities

The Institute's facilities based at the Scottish Microelectronics Centre (SMC) include a substantial design and test resource and a comprehensive silicon and MEMS fabrication capability. In addition to the extensive micro/nano fabrication equipment toolset the SMC also houses the SMC Analytical with SEM, AFM and FIB equipment for chip visualisation and repair.

Current Research

- Sensor-related projects include work on infra-red bolometer arrays (with NIST, UKATC, Cardiff University)
- A microhemorheometer (with Hatfield University).
University of Manchester
Sensing, Imaging and Signal Processing (SISP)

http://www.eee.manchester.ac.uk/our-research/research-groups/sisp/#d.en.256997

Description
The Group focuses on exploiting its broad expertise to address multidisciplinary measurement and signal-analysis problems in chemical, mechanical, electrical, security, and biological systems, and the building of sensor systems for users in academia, industry and healthcare.

Electronic materials, devices and sensors is a vertically integrated research theme spanning modelling and synthesis of atomic layer thin films, using Molecular Beam Epitaxy, to nanometre scale device fabrication to complete sensor system operating from kHz to THz frequency range for applications, including Non-Destructive Testing (NDT) and THz imaging. Other developments in SISP include a novel technology for the accelerated detection of landmines, measurement of focused X-ray beams, electrical capacitance tomography imaging of particle density in fluidised bed dryers, with applications in the pharmaceutical and food and energy processes industries.

Point of Contact
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Facilities
Molecular Beam epitaxy; III-V materials processing; high-speed DSP systems and software; Precision electromechanical scanning system; Advanced tomographic instrumentation and systems; Ultrasonic NDT systems; Biomedical systems and instrumentation; Hyperspectral cameras, tele-spectroradiometric and photometric systems. For further information visit http://www.eee.manchester.ac.uk/our-research/research-groups/sisp/facilities/

Current Research
http://www.eee.manchester.ac.uk/our-research/research-groups/sisp/research-areas/ipt/researchprojects/

http://www.eee.manchester.ac.uk/our-research/research-groups/sisp/research-areas/vip/projects/
University of Northumbria at Newcastle
Physics and Electrical Engineering/Smart Materials and Surfaces

http://www.northumbria.ac.uk/researchandconsultancy/research/engineering/

Description

The main area of research in the Smart Materials and Surfaces Laboratory is the design, production and analysis of materials and surfaces and their interactions with liquids. These interactions have applications in biomedical devices, for sensors and analysis, imaging and displays and biomimetic materials.

Point of Contact

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Facilities

- The Smart Materials and Surfaces laboratory is equipped with spin coating and electrospinning facilities for accurate and controlled surface preparation, contact angle measurement and analysis, including dynamic, advancing and receding contact angle measurement.
- High speed videography for capturing surface interactions.
- Video/fluorescence microscopy including Differential Interference Contrast (DIC) and Particle Image Velocimetry (PIV).
- 3D printing, surface profilometer, variable pressure Scanning Electron Microscope and Atomic Force Microscope, for surface characterisation.
- Tribo-Indentor and nano-mechanical system for nano/micro-mechanics.
- Quartz crystal microbalance (QCM) and assorted electrical characterisation equipment.

Current Research

- Superhydrophobic and superhydrophilic surfaces using combined micro and nano-structure and surface chemistry to control wetting.
- Electrowetting and dielectrowetting: Controlling Oleo- and Hydrophilicity and shaping liquid Surfaces: Using micro fabricated interdigitated electrodes and electric fields it is possible to change the hydro- and oleo- philicity of a surface and the wetting area or the shape of a droplet. Using dielectric elastomers to change the
shape of microchannels it is possible to create biomimetic systems which can affect or even cause flow in the channels. Rectified flow from an evaporating droplet or sublimating solid (including Leidenfrost effect) can be used for self-propulsion on a specifically patterned surface. Bio-inspired smart topo-surfaces with nano-/micro sensing effect.

- Creasing instability based tactile sensors.
- Stimuli-responsive surface induced sensor unit for micro-fluidic application.
- Sustainable manufacturing of sensor systems.
University of Plymouth
Research and Innovation

https://www1.plymouth.ac.uk/enterprisesolutions/Solutions/KT-Solutions/Pages/default.aspx

Description

The Wolfson Nanomagnetics Laboratory is a clean room based laboratory for leading edge research in nano-spintronics, computer memory and data storage technology, nano-functional materials and biosensors. This includes a range of thin film deposition, micro fabrication facilities, and magneto-transport as well as nano-scale metrological characterisation instrumentations. The 6-targets and load-locked device-scale spintronic film deposition tool is unique in a UK university.

Point of Contact

Enterprise Solutions
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E: enterprisesolutions@plymouth.ac.uk

Facilities

The Laboratory is fully equipped for the exploration of leading edge science and technology, with a wide range of applications in sectors such as communications, defence, aerospace, security and photonic surgery to medical and analytical instrumentation.

Equipment includes:

- Laser and electron microscopes
- Confocal laser microscope
- Magnetic and spin transport measurement systems
- Fully computer controlled MH, RH and spin torque switching, capable of measuring films as thin as 1nm
- Keithely dual channel V & I source/measurement meter for transistors
- Nano-R atomic force microscope with sub-nm resolution: for 3D characterisation of nano-scale devices and surface morphology, film thickness and surface roughness
- Nordiko 9550 spintronic deposition tool: 6-targets and load-locked device scale spintronic film deposition capability
- OAI submicron mask aligner: semi automatic with a minimum feature size of 0.8µm
Current Research

- Graphene technologies
- Head field simulation
- Label-free bio-transistors
- Metallic spintronic films and devices
- Semiconductor spin field effect transistors
- Signal processing
- Spintronic biosensors
- Thin film heads, media and micro/nanofabrication
University of Reading

Department of Chemistry

http://www.reading.ac.uk/chemistry/

Description

The nanoscience and materials activity at the university is led by the department of chemistry and brings together people from different departments including Chemistry, Mathematics and Pharmacy to solve scientific and technology challenges.

Point of Contact

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Facilities

The experimental facilities embedded within the various Departments and Schools and Centres are associated with the Network. This includes: Wolfson NanoScience Laboratory, Chemical Analysis Facility, Electron Microscopy Laboratory, Central Facilities (we have very strong links and joint appointments with central facilities such as the Diamond Synchrotron), Computation and modelling.

Current Research

Many of the research activities in the centre are under the following four categories:

- Catalysis, Sensors and Data Storage.
- Polymer Nanostructures.
- Bioscience and Pharmaceuticals.
- Biomimetic Nanostructures.

In particular, the research involves, Transition Metal Oxide Ultra-Thin Films as gas sensors. Synthesis, testing and characterisation of nano-sized solid-state materials as gas and bio-sensors. Novel materials as sensors for use in smart textiles.
University of Sheffield
Department of Materials Science and Engineering

http://www.materials.dept.shef.ac.uk/SCAMMD/

Description
The Department of Materials Science and Engineering has a long history of research excellence. The Department comprises of over ten research centres, covering a range of techniques and topics.

Point of Contact
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Facilities
The Department houses vibrating sample (VSM) and magneto-optic (MOKE) magnetometers, three vacuum deposition systems optimised for hard and soft magnetic films, a magnetic force microscope (MFM), and has direct access to the University of Sheffield Sorby Centre for Electron Microscopy (transmission and scanning electron microscopy (TEM & SEM) and the Sheffield-based national III-V Centre for lithography and device fabrication (optical, e-beam, focussed ion beam (FIB)).

Current Research
- Chemical sensing, in either aqueous or gaseous environments.
- Materials for mobile phone antennas.
- There is also expertise in the magnetics group in magnetostrictive materials and magnetoresistive materials.
University of Sheffield

The Polymer Centre

http://www.polymercentre.org.uk

Description

The Polymer Centre, established in 2001, represents 48 academic groups active in all areas of polymer science and engineering. Its members are drawn from seven departments in three Faculties at the University of Sheffield. The Centre offers technology and training opportunities to external partners and serves as a point of contact into the wider Polymer IRC (Bradford, Durham, Leeds and Sheffield), the UK’s largest polymer research cluster.

Point of Contact

Dr Joe Gaunt

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E: j.gaunt@sheffield.ac.uk

Facilities

International standard chemical, physical, engineering and medicinal preparatory facilities.

Measurement instrumentation manned by expert technical staff.

Current Research

Please contact for full details. Examples include:

- Self-sensing and self-healing smart materials.
- Damage detection systems, cure monitoring systems and through-life monitoring of environmental and mechanical degradation.
- Applied Molecular Engineering.
- Building organised, stimulus-responsive molecular architectures using a wide range of materials, especially designed block copolymers.
- Targets for sensing include bacteria, gases, organic vapours, heat and diverse dissolved contaminants.
- Detection may be observed through shape, electrical or colour / luminescence / spectroscopic changes.
University of Sheffield Hallam
Materials and Engineering Research Institute

http://www.shu.ac.uk/research/meri/index.html

Description

MERI (formerly MRI) has been a centre for research excellence in materials since 1990.

Key strengths of the institute lies in the following areas: Materials Systems, Performance and Reliability, Intelligent Systems, Vision and Robotics, Sustainable and Green technologies, Healthcare and Biosciences.

Point of Contact

Business Services

T: +44 (0) 1142 255000

E: business@shu.ac.uk

Facilities

The centre offers a consultancy service which is mainly aided by the range of state-of-the-art instruments and techniques. A detailed list of the facilities can be found here: http://www.shu.ac.uk/research/meri/equipment/index.html

Current Research

The development of sensors of highly volatile and explosive organic vapours - The research work in QCM sensors of volatile and explosive organic vapours has resulted in the development of several sensor devices starting from the simplest QCM fire/explosion alarm devices, then QCM sensor arrays also capable of recognition of vapours, and finally with QCM impedance and QCMD methods which are capable of both identification and concentration evaluation of organic vapours using even a single crystal. The optical sensors based upon SiO2/Si3N4 planar waveguides coated with composite electrostatically films containing both organic chromophore and enzyme molecules. Planar waveguide sensors. Light emitting semiconductor nano-materials. Optical enzyme sensors. Nano-structured materials for micro- and opto-electronics. Characterisation of novel cathode materials. Sol-gel based bio-sensor that can detect low levels of phenol in water samples.
University of Southampton
Optoelectronics Research Centre/Integrated Photonic Devices Group

http://www.orc.soton.ac.uk/ipd.html

Description

The Optoelectronics Research Centre (ORC) is a research-only school, with around 20 groups covering a wide range of areas, all concerned with the study, manipulation and exploitation of light (photronics), and photonic devices, with advanced fabrication facilities for optical fibres and planar lightwave circuits. There are around 70 PhD students at any time working in the ORC, but there are no undergraduate or postgraduate taught courses. The Integrated Photonic Devices Group is part of the ORC and exploits surface science, waveguide engineering, laser physics and microstructure technology to realise robust mass-producible integrated optical circuits, to further the monolithic integration of diverse devices, and to develop novel materials processing for optoelectronic devices. It has carried out work on planar waveguide based optical chemical and biochemical sensors, particularly for environmental monitoring applications, including those based on surface plasmon resonance (SPR), and fluorescence. Spin-offs from the ORC include Stratophage, SPI Lasers and ChG.

Point of Contact

Professor James Wilkinson

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E: jsw@orc.soton.ac.uk

Facilities

The group has responsibility for running the “InterFab” cleanroom facility for optical, electronic and microfluidic device fabrication. Processes include photolithography, thin-film deposition, dry and wet etching, bonding and diffusion and these are supported by metrology facilities and comprehensive optical measurement and characterisation laboratories.

Current Research

Recent fluorescence-based devices include a 32 analyte array sensor which can monitor organic pollutants such as oestrone down to the 1ng/L detection level.
Current projects, most in collaboration with other groups within the ORC and elsewhere include:

- Integrated optical fluorescence immunoassay sensor instrument
- Waveguide lens systems for the integrated lab-on-a-chip
- Integrated optical manipulation and selection of stem cells
- Optical waveguide sensors for highly sensitive detection and quantification of cytokines in biological fluids
- The fabrication and applications of fibre nanowires and related devices
- Trapping and propulsion of micro- and nano-particles at surfaces

Recent projects, in collaboration with other groups within the ORC and elsewhere include: EU AWACSS & RIANA – fluorescence based multianalyte testing of river water, EU BIOPTICAS – monitoring of pesticides in groundwater, Electroassisted optical sensors for metal ions, Integrated optical sensors for beverage analysis, Integrated optoelectrochemical sensor chips for lipid membranes.
University of Southampton
Southampton Nanofabrication Centre (SNC)

http://www.nano.ecs.soton.ac.uk/

Description

The interests of the Southampton Nanofabrication Centre is focused on fabrication and engineering at the nanometre-length scale to produce a wide range novel devices and integrated systems. This includes the creation and characterization of new metamaterials and the study of biomimetics, which aims to borrow evolutionary solutions to optical and mechanical problems from the natural world. Current research topics encompass MEMS/NEMS devices, photonic crystal circuits, solar cells, new materials, atom chips, Lab-on-a-Chip, particle manipulators, nanomagnetic materials and devices, nanophotonics, RF devices and quantum information devices.

Point of Contact

Professor Shinichi Saito
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Facilities

The Southampton Nanofabrication Centre houses a £110 million state of the art clean room for the fabrication and characterisation of nanostructures, devices and systems. The Centre works with industry on a variety of research projects and also offers industrial access to the clean room.

Nanofabrication facilities include:

- Jeol JBX 9300 electron beam lithography.
- EVG 6200 Infinity optical lithography.
- Zeiss NVision 40 focussed ion beam system.
- OPT Sys 100 liquid source PECVD insulator deposition system.
- OPT Sys 100 PECVD doped polysilicon deposition system.
- Rapid thermal and furnace annealing and oxidation.

Nanocharacterisation facilities include:

- Zeiss Orion Helium Ion microscope.
- Jeol JSM 7500F FEGSEM.
• Agilent 8361A microwave vector network analyzer & Cascade Summit 12000B-AP probe station for on-wafer characterisation up to 67 GHz.
• Lambda Photometrics MSA400 scanning laser vibrometer for microsystem characterisation up to 20MHz.
• Lakeshore EMTTP4 probe station with magnetic field, 5-475K.

Current Research

• Design and fabrication of multi-axis linear and angular motion sensors.
• The long-term vision is to have a 6 degree-of-freedom inertial sensing system on-a-chip, integrated with the interface and control electronics.
• The integration of micromachined sensing elements in closed loop feedback systems: development of advanced control concepts based on higher order sigma-delta modulators - conceptually similar to purely electronic A/D converters.
• This approach adapted to MEMS sensors has the potential to result in high-performance transducers with improved signal-to-noise ratios.
• Development of single molecule biosensors and artificial bilayer membrane devices.
• Lab-on-a-Chip and micro-analytical devices.
• Optical bio-sensing techniques: surface plasmon resonance microscopy.
• Silicon nanowire biosensors for point-of-care diagnosis.
University of Southampton
School of Chemistry

http://www.soton.ac.uk/chemistry/research/index.shtml

Description
The school has over forty research groups in covering a wide range of areas of Chemistry.

The research activities are divided between five research sections: Molecular Assembly, Function and Structure; Chemical Diagnostics and Therapeutics; Computational Systems Chemistry; Magnetic Resonance; and Electrochemistry. Groups in the Electrochemistry Section have active research programmes in biosensors, biofuel cells, nanostructured materials, sonoelectrochemistry, scanning electrochemical microscopy, SERS, electrocatalysis, fuel cells, analytical chemistry, carbon nanotubes, solid state electrochemistry, batteries, the metal/solution interface and electro-deposition.

Point of Contact
Professor Phil Bartlett
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E: pnb@soton.ac.uk

Facilities
X-ray crystallography, NMR. mass spectroscopy, materials synthesis, including a dedicated high-pressure research laboratory, glove box and furnace rooms, and purpose designed and built equipment for catalysis/catalyst characterization. State-of-the-art computer clusters to support the computational studies.

Current Research

- Application of biological electron transfer processes in sensors, bioelectronic devices and biofuel cells.
- Development of chemically modified electrodes for applications in bioelectrochemistry.
- Modelling of electrochemical biosensor responses.
- Surface Enhanced Raman Spectroscopy and plasmonic structures. DNA sensors.
University of Swansea
The Centre for NanoHealth

http://www.swansea.ac.uk/nanohealth

Description

Established in 2009, the Centre for NanoHealth at Swansea University, a purpose built open access facility, combines nanotechnology with medical science to provide opportunities to develop innovative solutions to the world’s challenge of detecting the onset of diseases at the earliest stage. Novel devices, processes and sensors can be designed, manufactured, functionalised, tested and evaluated for point of care, near–patient and in vivo applications.

Point of Contact

Dr. Matt Elwin

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Facilities

The building consists of 1600m$^2$ of state-of-the-art facilities including dedicated laboratory space and offices for research, academic and project staff. The CNH offers a fully integrated nanotechnology and biomedical Research & Development environment. Incorporated is:

- A fully equipped nano-fabrication and characterisation class 1000/100 cleanroom for silicon and non-silicon based developments
- A class 1000 bioclean room for tissue engineering and device functionalization, NMR, rheology, biomolecule printing, AFM, SEM, and photonics.
- The centre includes a category 2 biomedical suite of laboratories offering cell and molecular biology capabilities, including confocal microscopy, and high-throughput/high-content analytical systems (Amnis Imagestream & GE In Cell); microbiology, regenerative medicine and tissue engineering: and nanogenotoxicology.
- CNH can also offer access to incubation space as private offices, a clinical research facility and access to a ‘first into man’ clinical trials unit and MRI/CT patient imaging and health informatics. The centre offers expertise and equipment in:- Biology and advanced cell imaging.
- The centre includes a category 2 biomedical suite of laboratories offering: Molecular biology with real time PCR systems from Biorad; Tissue culture, including a separate isolated lab for culture of primary tissues; Microbiology; Tissue Engineering and
Regenerative Medicine; Nano(geno)toxicology; Cell imaging suite comprising high-throughput/high-content analytical systems (Amnis Imagestream flow cytometer, IMAS-Zeiss Meta systems micronucleus detection & GE InCell analyser 2000); Zeiss LSM710 Confocal Microscope and a combined JPK Nanowizard AFM/Zeiss LSM Confocal Microscope system. - Characterisation with equipment capable of electrical, physical & chemical analysis.

- Equipment includes: Hitachi S4800 Scanning Electron Microscope SEM (~1nm resolution) with cryo stage, STEM and EDX techniques; JPK Atomic Force Microscope (AFM) including electrical mode; Raman Spectroscope (high throughput and combined AFM, TERS SNOM system); Nanoprobe, the system is fully equipped for Nanoscale imaging and physical and electrical characterisation. It also includes high resolution scanner Auger capability for surface chemical analysis; Particle characterisation (Quantachrome NOVAe & Malvern Zetasizer Nano); Nuclear Magnetic Resonance system; Rheometers; Gas Analyser. - Micro-Nano fabrication from sensors and devices, microfluidics & MEMS to printing & coatings. Incorporated is a fully equipped nano-fabrication and characterisation class 1000/100 cleanroom for silicon and non-silicon based developments, a class 1000 bioclean room for tissue engineering and device functionalization and biomolecule printing. Class 100 photolithography lab including: SUSS Microtech MA8 mask aligner (200mm wafer capability); SUSS Substrate conformal Imprint lithography system (30nm features); Raith E-line electron beam lithography system (10nm features).

- Class 1000 area includes: SPTS Plasma Enhance Chemical Vapour Deposition (200mm wafer capability); SPTS Inductively Coupled Plasma etch (200mm wafer capability); Physical Vapour Deposition; Anealsys Rapid Thermal Anneal; Wafer Prober; MakerBot Replicator 2; ATV Diamond Scribers; Copper Electroplating; GX Semiconductor and Metallurgical Microscope.

- Class 10000 bio clean room includes: Microscopes & micromanipulator; Ruskinn controlled environment cabinet; Electrosspinner for producing nanofibres. The Printing and Coating lab in CNH includes: Areosol Jet Deposition System (10µm features); Optomec; 3D Bioplotter. Collaboration is strategically imbedded within the academic and business ethos of the centre. The centre is committed to supporting SMEs to multinationals with an interest in nanotechnology and healthcare and to form strategic partnerships to develop and drive forward the centre’s research and commercialisation vision.

**Current Research**

Development of a nanoscale sensor that would sit in the body, capable of detecting the growth of cancerous cells in high-risk patients and for monitoring post-treatment relapse. Gas Sensing with Metal Oxide Semiconductors - understanding the performance of
nanocrystalline metal oxide semiconductors (such as SnO2 and WO3) for gas sensing applications. AFM probe techniques based on the immobilisation of small particles such as cells to measure the nanoscale forces that keep cells attached to surfaces. Study of Shewanella oneidensis an electrochemically active bacterium. Power management and sensor systems for nanoscale devices.
University of Teesside
Technology Futures Institute

http://www.tees.ac.uk/sections/research/technology_futures/

Description

The Technology Futures Institute carries out work from research to innovation in the process, energy and environment, life sciences and security sectors. Their work encompasses the use of micro and nanomanufacturing processes with the development of associated sub-systems for the creation of smart devices. They carry out work on chemical and biological processing of fluids for information content. This includes handling of fluids, automated biological manipulations and transduction development for event recognition. The other areas include work on electronic systems design for interrogating devices, including signal processing and data transfer.

Point of Contact

Professor Zulfiqur Ali

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E: z.ali@tees.ac.uk

Facilities

Our Micro and nanomanufacturing facilities include clean room microfabrication technologies such as photolithography, wet and dry etching and sputtering as well as associated technologies such as photo electroforming, micro-milling, micro-injection moulding and laser microstructuring.

Current Research

- DVT-IMP, a major EU-funded project coordinated by us, that will develop a point-of-care device to aid the diagnosis of Deep Vein Thrombosis (DVT) and Pulmonary Embolism (PE). The device is based on measuring a marker for these conditions in the patient’s blood.
- Diginova – Developing a roadmap for digital fabrication.
- Miniaturised bioreactor for biological processing.
University of York

York JEOL Nanocentre

http://www.york.ac.uk/res/nanocentre/

Description

The York JEOL Nanocentre represents a major long term collaboration between the University of York, Yorkshire Forward, through them the European Union, and JEOL who are world leaders in electron optics.

Point of Contact

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Facilities

The Nanocentre currently includes 5 core tools:

- An ultra high resolution (1Å) Field Emission Transmission Electron Microscope, with Cs Aberration Correctors for both TEM and STEM, in purpose built accommodation with remote control and microanalysis.
- A Dual Beam Focused Ion Beam miller (DBFIB). A Scanning Probe Microscope with a range of capabilities for atomic and magnetic force imaging, and hot stage experiments.
- A High Resolution SEM/E-beam Lithography system with full EDX chemical microanalysis and mapping capability.
- A conventional (2Å) High Resolution Transmission Electron Microscope with CCD Camera and EDX chemical microanalysis.

For further information, please visit: http://www.york.ac.uk/res/nanocentre/facilities/

Current Research

- Surface science
- Catalysis
- Nanomaterials
- Atomic processes
- Electron microscopy developments
- Fundamental understanding of atomic processes and reactivity at solid surfaces in gas-solid reactions, structures of nanomaterials, molecular and nanotechnology
- Design of new nanomaterials, especially nanoparticle composite systems, their synthesis, structure and properties
- Manipulation and study of the structures and properties of novel bimetallic nanoparticles, zeolites, nanoscale oxides and metallic clusters for alternative energy sources (including hydrogen and solar), environmental control, hydrocarbon oxidation and polymerisation, and nanomaterials for electronics and sensors.