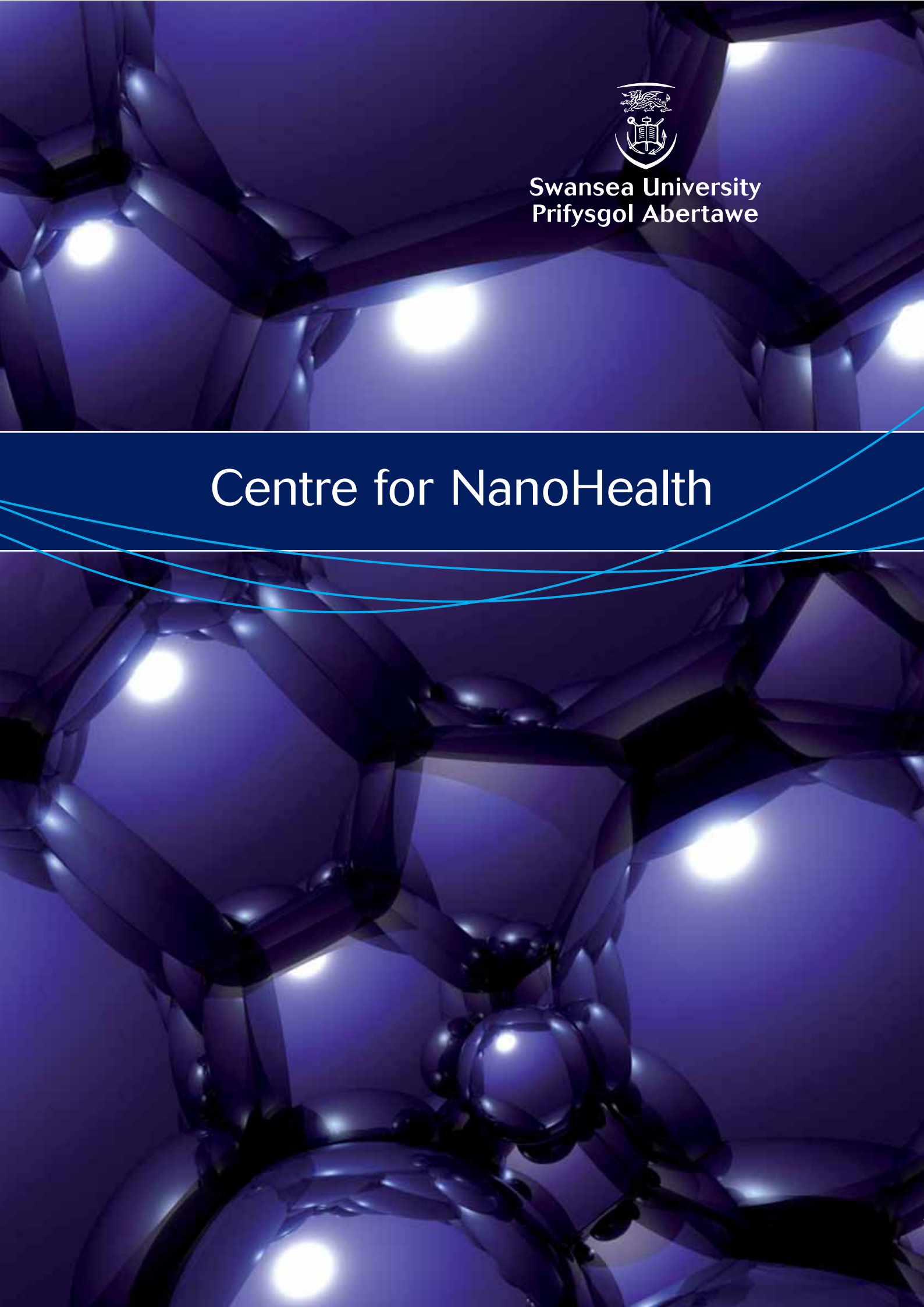
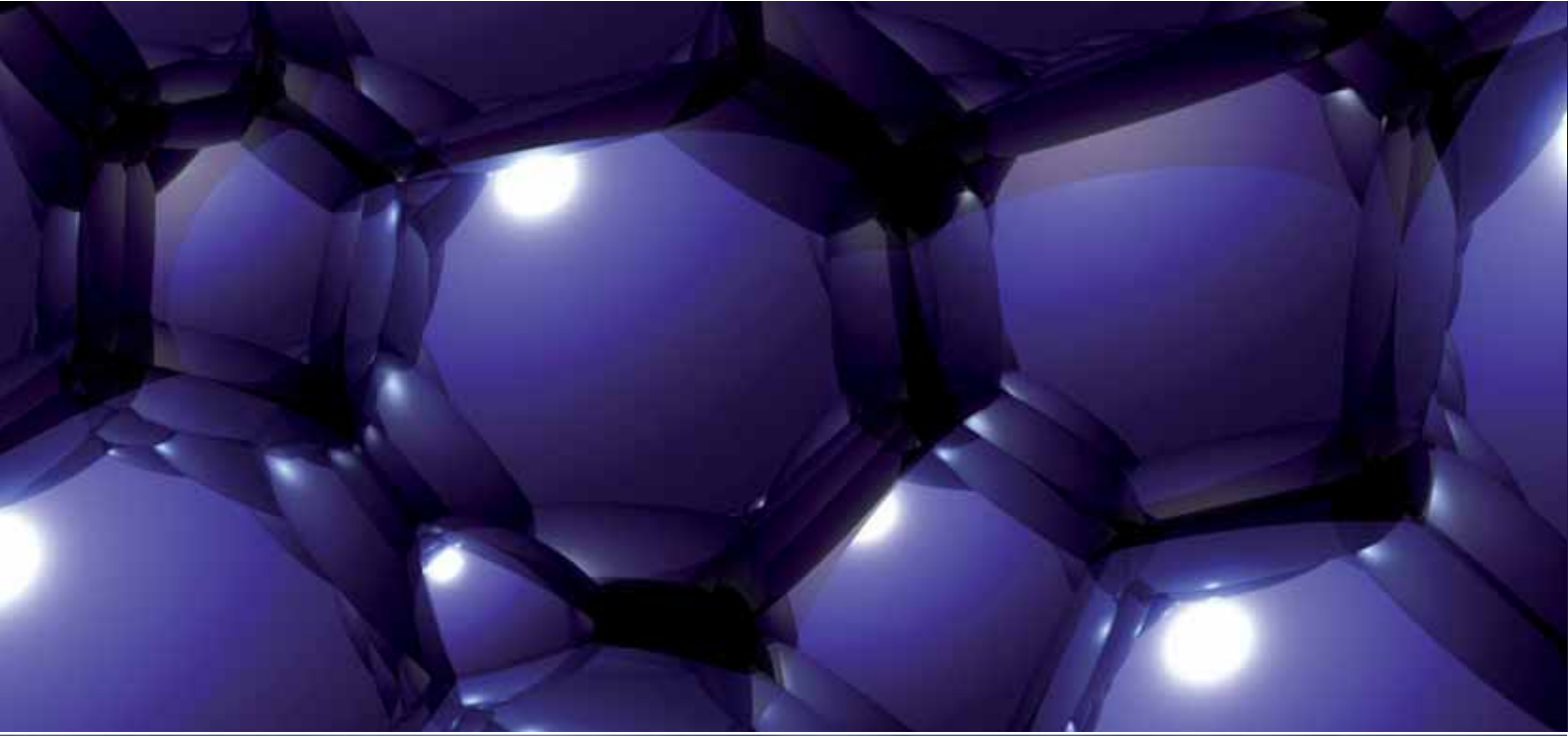
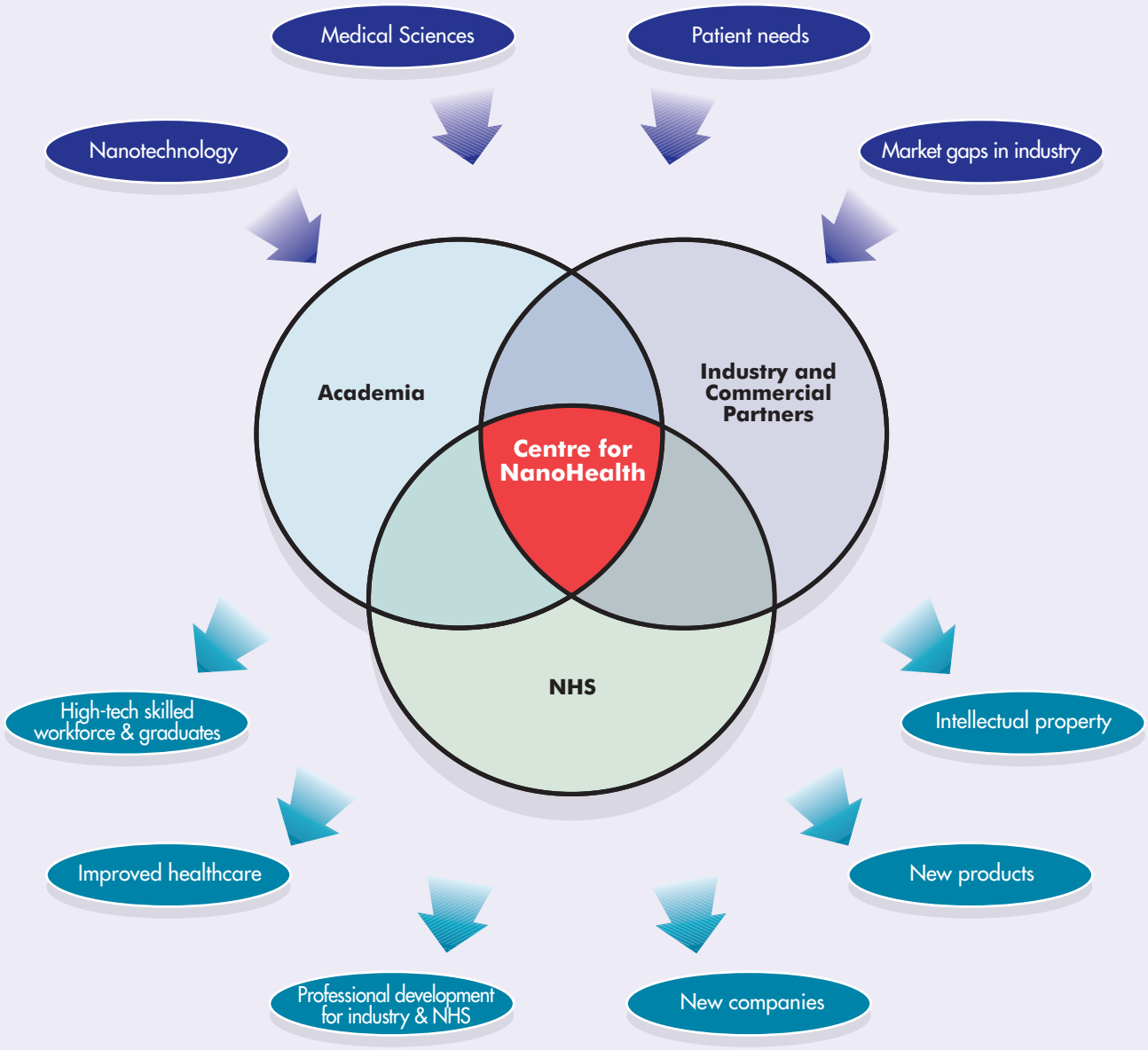


Swansea University
Prifysgol Abertawe

Centre for NanoHealth



A unique interdisciplinary research initiative leading innovations in healthcare based on the application of nanotechnology.


Medical Sciences
Patient needs
Nanotechnology
Market gaps in industry
Academia
Industry and Commercial Partners
Centre for NanoHealth
NHS
High-tech skilled workforce & graduates
Intellectual property
Improved healthcare
New products
Professional development for industry & NHS
New companies


The Centre for NanoHealth is an
immensely exciting new concept,
bringing together world-class
research activities..

One of the biggest challenges facing the future of healthcare is enhancing early intervention in diagnosing and treating diseases in non-hospital environments; in the home, community clinic or local doctors' surgery.

Current medical practice is based around relatively late intervention, which with many diseases does not result in complete cure, but rather extends a patient's life whilst, hopefully, maintaining quality of life.

The key to early intervention is the earliest possible detection of disease, and the swift identification of appropriate medical or surgical treatments.

The collaboration between Swansea University's Schools of Engineering and Medicine in partnership with industry and Swansea National Health Service (NHS) Trust to apply Nanotechnology to Healthcare offers a unique opportunity to make a step change in the way healthcare is approached.

Technology, and particularly Nanotechnology, has an increasingly important and strategic role to play in furthering our ability to detect and treat disease, and this has been central to the work of the University's Multidisciplinary Nanotechnology Centre (MNC), established within the School of Engineering in 2001.

Coupled with developments in biomarker discovery in Biomedical research at the School of Medicine's Institute of Life Science (ILS), the challenges that can be overcome through Nanotechnology have the potential to lead to novel devices, processes and sensors essential for the earliest detection of disease onset, developed for point of care, near–patient and in vivo application.

Nano-devices and Nano-biosensors will permit the detection and measurement of biomarkers present in fluid or tissue samples at a level of sensitivity far beyond current detection methods; in the parts per billion range.

The Centre for NanoHealth (CNH) will be located within a Clinical and Biomedical research environment on Swansea's Singleton hospital site, giving access to patients and creating a pioneering, integrated facility in which novel devices and sensors can be designed, manufactured, functionalised, tested and evaluated.

The Centre for NanoHealth is an exciting new concept that will quickly become a globally significant centre of excellence in the ground-breaking field of nanotechnology applied to health and medicine.

The Centre harnesses the research expertise of our internationally recognised academics. Its potential to enhance healthcare provision and to impact on patient well-being cannot be overstated, and we are confident that work undertaken in Swansea will lead to pioneering discoveries in the detection of, and intervention in, major diseases.

Academic collaboration with industry is a dynamic driver of economic growth, creating jobs and wealth, and leading to commercially viable new products. As an ambitious university, we are already benefiting from the substantial support of a number of internationally renowned commercial organisations, not least because we are located firmly in a European Objective 1 area that gives us access to Convergence Funding to further our links with industry. Companies we are proud to have collaborative research links with include Alliance Boots Plc, Corus, Rolls Royce Plc, Airbus UK, and IBM.

The support of new, visionary industrial partners is essential if we are to make real progress in applying nanoscale technologies to the challenges faced by the healthcare profession.

I hope that you will join us.

R. D. Davies

Professor Richard B. Davies

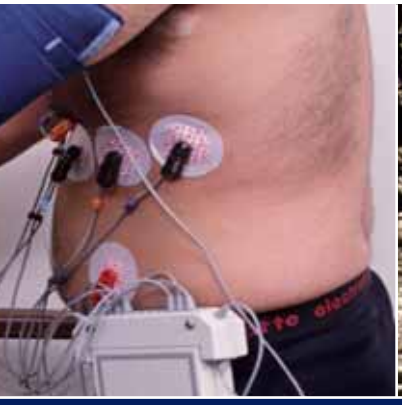
Vice-Chancellor, Swansea University

Nanotechnology: impacting on health

Research developments in the Centre for NanoHealth have the potential to make a genuine impact upon the global healthcare industry.

'The powerful combination of research and technical expertise provided by both Swansea University and IBM was a major factor in our decision to locate our Centre for Innovation in the Institute of Life Science at Swansea University.'

LIZ MORGAN, DIRECTOR OF THE BOOTS CENTRE FOR INNOVATION

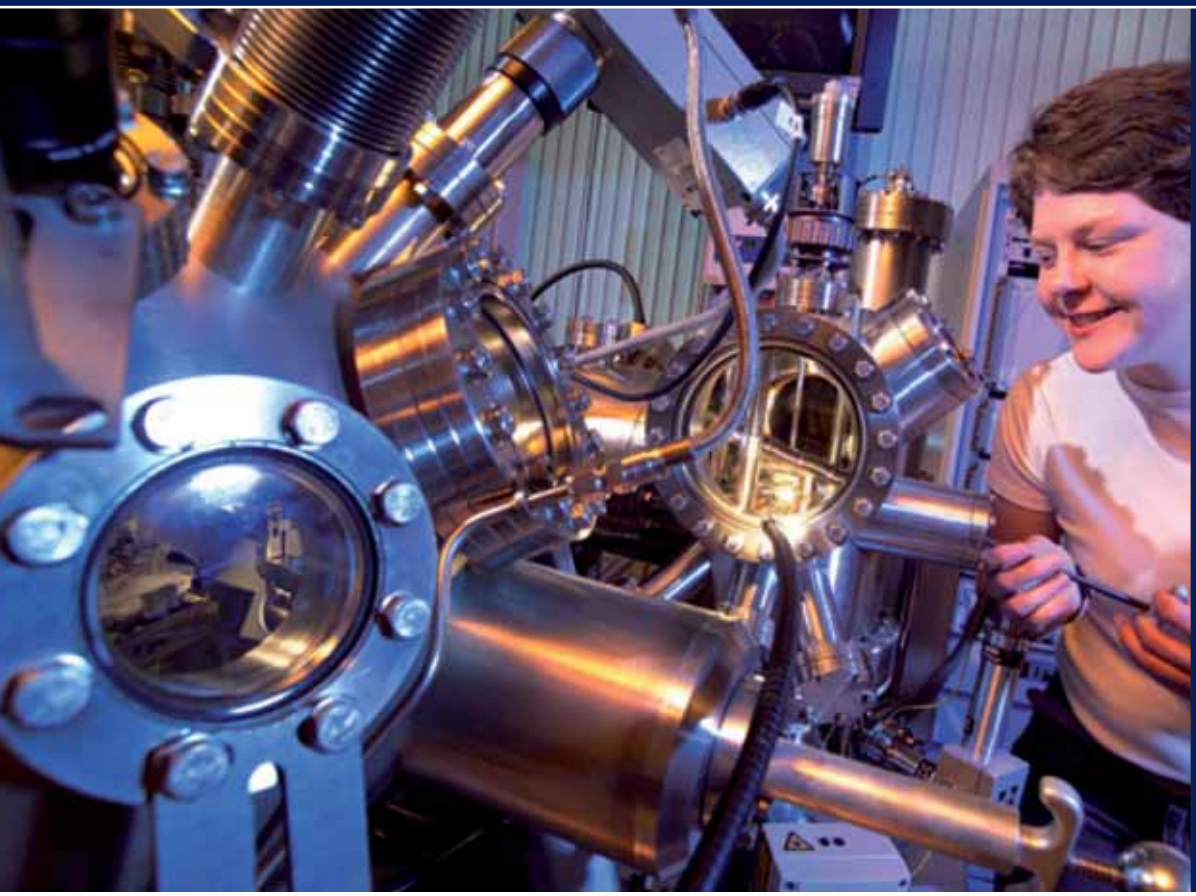


Obesity

Cancer

Cardiovascular problems

Diabetes



Key CNH research areas

- Sensors and devices
- Imaging
- Modelling
- Tissue monitoring and integration
- Bio discovery/ production

A collaborative partnership

The Institute of Life Science (ILS) and Multidisciplinary Nanotechnology Centre (MNC) have been collaborating effectively over recent years and the CNH is a natural progression of this highly productive relationship – a partnership that is already realising significant benefits for the University and the region. Notable achievements include the award of four prestigious Research Councils UK Fellowships in Nanomedicine jointly to the ILS and MNC.

The ILS is a £50 million initiative that incorporates all research activity within the School of Medicine at Swansea University. Funded by the Welsh Assembly Government, the European Parliament and IBM, it brings together multidisciplinary research teams in an environment that fosters collaboration with industrial partners and the creation of new business.

A significant proportion of the Pan Wales MNC portfolio now lies in the area of biomedicine. With capacity now at a limit it is vital that this arm of activity is expanded rapidly and significantly. Equally the ILS has identified Nanotechnology as a vital component of its research strategy, and this was embedded in the successful bid for the original ILS concept. Translation of Nanotechnology to benefit health is a collaboration between the MNC and ILS.

The application of advanced imaging, rheology, and sensor and device technology has already allowed members of the MNC and ILS to make significant advances in understanding the structure of biomolecules, cell surfaces and the complex interactions involved in blood coagulation. Real-time sensing of biomolecules and the utilisation of engineered surfaces to control cellular proliferation and differentiation are therefore realistic medium term translational goals in the programme of application of Nanotechnology to health.

International Links

The CNH Executive Team regularly collaborates with other leading universities and organisations in the fields of engineering and medicine. Throughout each year, members of the team are invited as guest speakers at major international conferences.

Swansea University is a member of the European Technology Platform in Nanomedicine.

In 2007 the University was approached by Rice University Texas to be a partner in 'The Texas/UK Collaborative' as one of the top UK universities working in the field of NanoHealth.

Swansea University was co-organiser of the first European ESF Summer School in Nanomedicine, attracting over 150 delegates from around the world.

Building on successes

Both the MNC and ILS have enjoyed great success over the last few years, winning millions of pounds of funding and attracting major names in industry and research.

Institute of Life Science (ILS)

- £52m collaborative venture between IBM, Swansea University and the Welsh Assembly Government
- Largest ever investment on a university campus by the Welsh Assembly Government
- Multi and inter-disciplinary environment with over 25 specialist research teams
- Dedicated business development team, integrating technology transfer, IP and business incubation expertise
- Incorporates Blue C, one of the world's fastest supercomputers dedicated to medical research

Multidisciplinary Nanotechnology Centre (MNC)

- A 'model' centre for multidisciplinary research which has established boundary projects between disciplines and institutions through natural evolution
- Research Income of around £10 million since the Centre's conception in 2001
- Over 100 researchers working within the Centre
- Achieved sustainability through research funding £3M EPSRC PP in addition to around £3M from EPSRC, DTI, NERC and NHS
- Established a new masters degree in Nanotechnology

07 Initial development and key partner identification

08 EU Covergence bid submitted; Project funding finalised; Lead CNH staff recruitment begins; Facility build begins and CNH business unit becomes operational

09 Fully integrated new building will be ready for CNH occupation

Cellular and Molecular Biomedicine Discovery and Production facilities

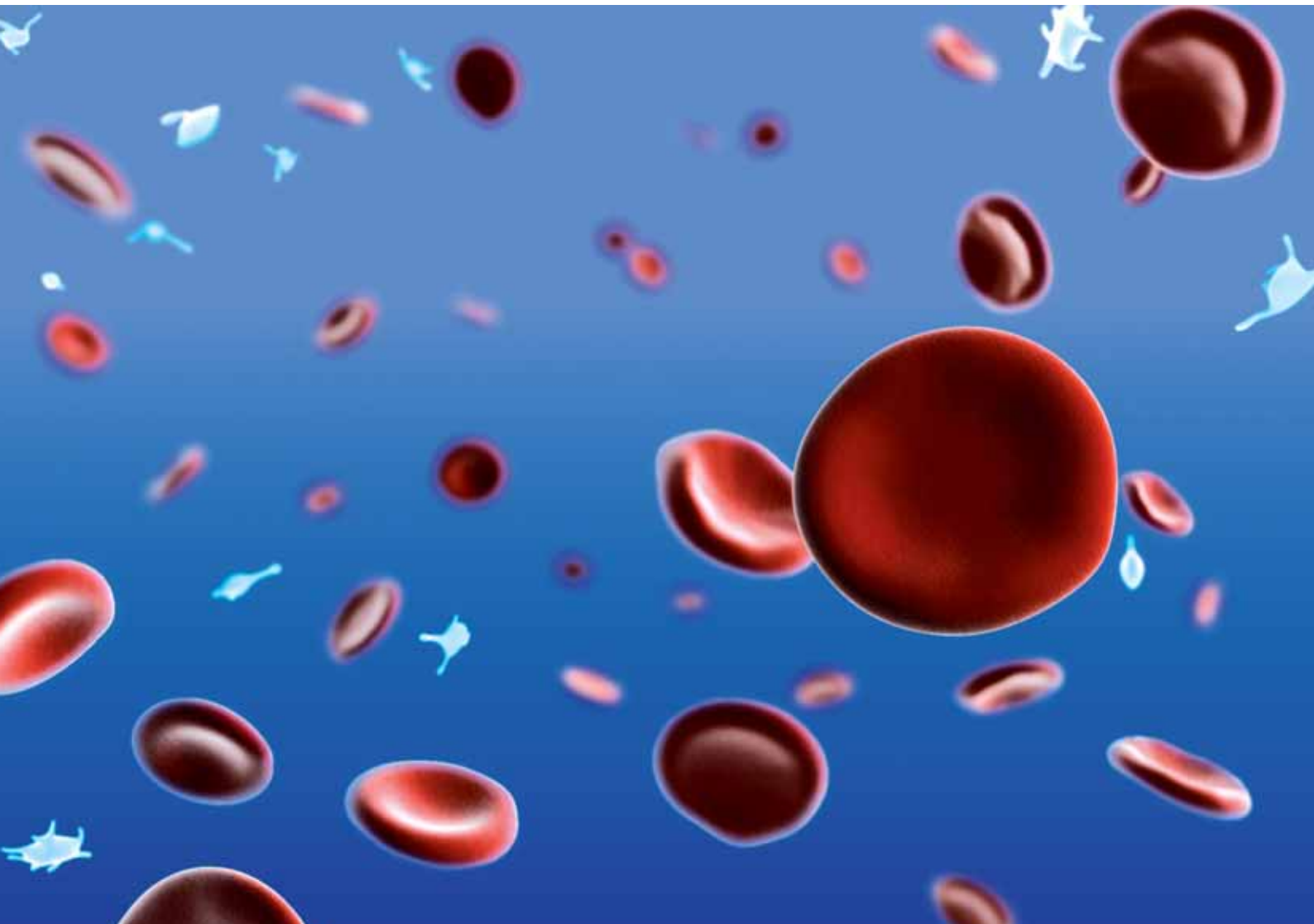
Biomarker discovery and validation of utility in healthcare will reveal candidate molecules for production as biofunctionalised nanosensors. This will achieve levels of detection in the parts per billion previously unachieved and facilitate early detection and treatment intervention.

The additional capacity for real time monitoring of prognostic indicators and their response to therapy will provide dynamic analysis suitable to deliver personalised medicine.

Embedded Class 2 biological facilities within the CNH will benefit the following:

- The production and isolation of molecular probes to be used in investigating biological response in model systems and disease tissue. The facilities will include capability to genetically modify, isolate and validate authenticity of derivatives within a contained environment. Lead molecular probes will be those selected for prototype development and validation.
- Cell culture facilities for propagation of model cell lines and isolation of cell derivatives from fresh biopsy specimens obtained from patient material during disease diagnosis and therapeutic testing.
- Capacity to characterise at the nano scale the distribution and fate of biomolecules developed as diagnostic and therapeutic targets. Such a facility will contribute to validation and fundamental assessment of biological process within systems under investigation.
- Biofunctionalisation of devices and materials with molecular probes produced and isolated under contained, well control conditions free from potentially confounding biologicals.
- Generation of scaffolds, for tissue engineering, containing well characterised cellular components in defined orientation to maximise functional interaction that enhance growth and differentiation. These will particularly benefit procedures involving isolation of limited cellular material, for example, progenitor stem cells and small pools of differentiated cells. Validation of such bioengineered structures, and the development of cell isolates within them, by nanoscale imaging to reveal molecular analysis will be achieved within a contained environment free from contamination.

This cell and molecular facility will therefore provide, in a contained biological environment, a unique link between a clinical unit and nanoscale engineering.



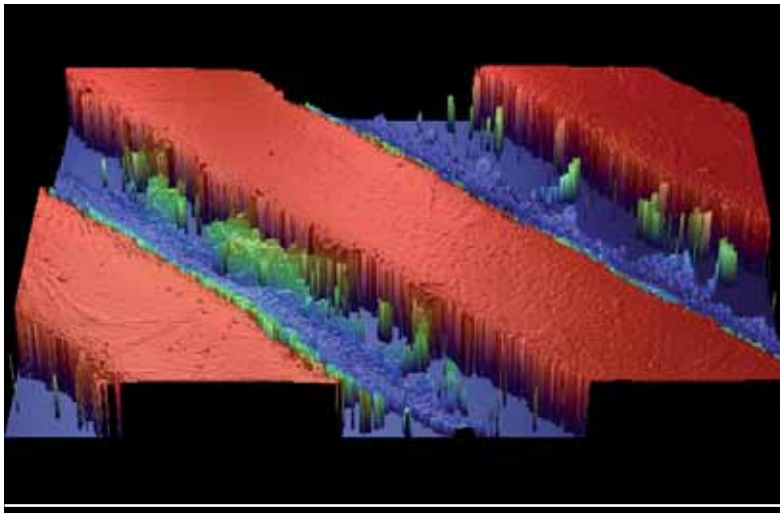
Printing: from concept to production

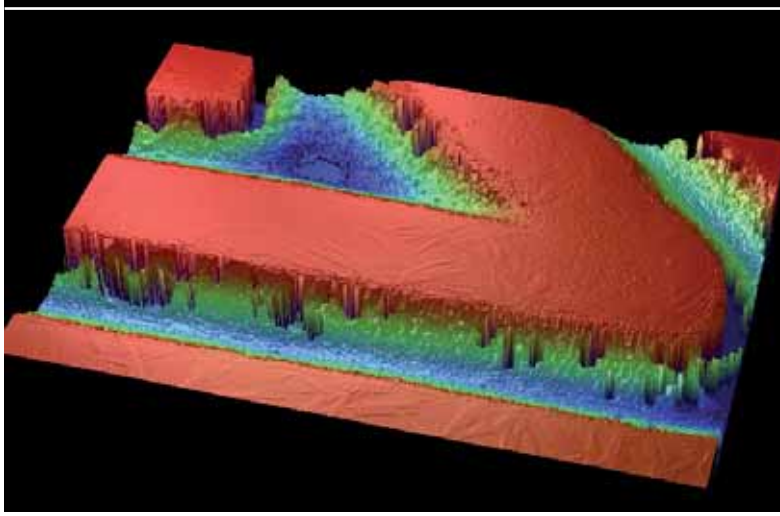
An open access facility for product development

Printing has the potential to turn concepts in nanotechnology into volume products. It is the vehicle to manufacture a diverse range of healthcare products.

This unique laboratory will provide an open access facility in a clean room facility for companies to explore and develop printing technologies for health care applications.

Support for this will be provided through world leading technical expertise in printing science developed through its application to graphics and polymer electronic products. This combined resource will enable ideas for applications of NanoHealth to move from bench test, through prototyping to small batch production for pilot trials.





Bio materials, such as enzymes, DNA and collagen, each require different processes to be printed successfully. CNH will house all forms of printing processes that are appropriate for bio materials. These will include screen, ink jet, flexo, gravure and pad. It will also include emerging technologies such as ink jet variants and low stress systems based on atomising technologies. This will allow the best process to be selected to achieve the required feature geometry without compromising the performance of the biomaterials.

Before a print can be made the novel materials must be turned into an ink. A pilot scale ink making plant is included to enable bio inks to be developed and optimised incorporating novel materials, such as nano particles and wires, enzymes, biomarkers and DNA. This facility will be further enhanced by the capacity to integrate printed polymer electronics into devices. All of this equipment is capable of short run production, thus a product can be developed to the point of volume manufacture, including identification of production control and quality assurance requirements.

Printing is capable of producing three dimensional structures, so has the potential to mass produce scaffold, cell/tissue structures and flow guides for micro fluidic devices that may be incorporated into diagnostic devices.

Current projects include optimising enzyme inks for sensor production, development of gas sensors for diabetes and microbiology, printing smart biological scaffolding, and integrated DNA sensors. Work is underway on the integration of plastic electronics, optical detectors and smart packaging. With the breadth of fundamental printing science available, the scope for projects is only restricted by the imagination.

Sensors and devices

In vivo sensing is one of the holy-grail technologies sought by the clinical profession. It permits real-time detection of biomarkers by a sensor embedded in the body that transmits the information for remote external detection.

The applications of such an early warning system can be envisaged across a variety of clinical problems. There is immediate scope for application within major diseases such as Cancer, Obesity, Cardiovascular issues and Diabetes, where the ability to detect the presence of biomarkers at an early stage, at a level of sensitivity far beyond conventional diagnostic techniques, would greatly contribute to decreasing mortality rates in such cases. A focus of the CNH is therefore to conduct research and develop biocompatible electronic nano-sensors that will have a detection limit in the part per billion range.

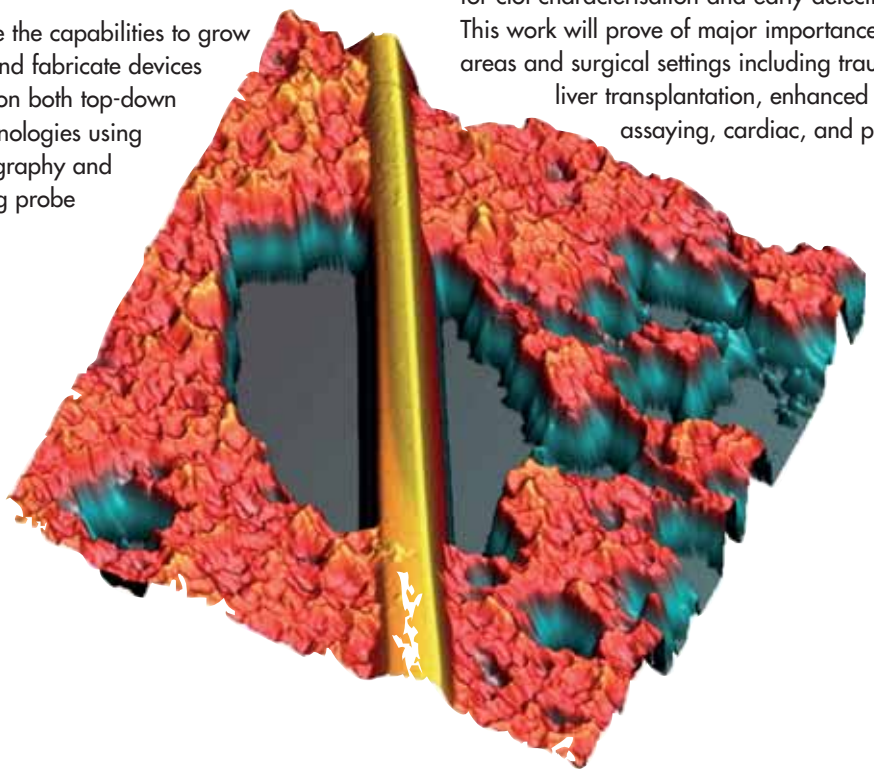
Central to this goal will be a modern clean-room facility embedded in a category 2 biological environment, providing state-of-the-art equipment necessary to engineer nano-devices, and facilitating direct integration for the first time. A unique characteristic of this facility will be the provision for scientists/engineers to work with non-silicon based materials (such as zinc oxide, smart polymers and carbon-based materials) that have huge potential in terms of the manufacture of biosensors.

The facility will have the capabilities to grow the new materials and fabricate devices and sensors based on both top-down and bottom-up technologies using electron beam lithography and multiple tip scanning probe microscopy systems respectively. This will be linked directly with a functionalisation facility making the devices and sensors biomarker specific.

This research and development environment will open up exciting opportunities for inward investment, as existing facilities are limited to working with traditional silicon-type based platforms. Creating this novel environment will immediately establish CNH as a recognised centre for innovation on an international stage.

Biomarker screening will not be limited to screening of 'classical' features of biomolecules such as DNA and peptide sequence, but will also target other properties, for example detecting properties of fluids and gels, including transitions between these states, as well as cell mobility and adhesion properties. Developments in rheometrical techniques, high frequency shear wave propagation devices, rheo/dielectric analysis, Diffusive Wave Spectroscopy and NMR Diffusometry/NMR Micro-imaging will provide the basis for the development of high-throughput scaleable technologies for characterising biogel/biofluid and tissue microstructures.

A current research focus has special reference to the analysis and characterisation of blood clots and rheometrical devices for clot characterisation and early detection.
This work will prove of major importance in several clinical areas and surgical settings including trauma, liver transplantation, enhanced haematological assaying, cardiac, and plastic surgery.



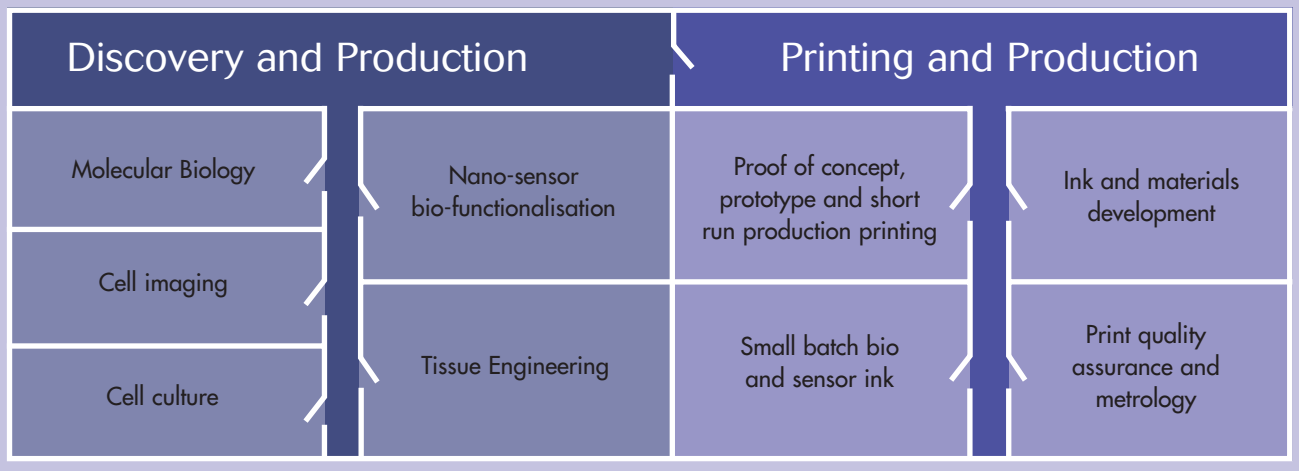
A Category 2 Bio-Environment with an integral Nano-Cleanroom

Facilities within Centre for NanoHealth

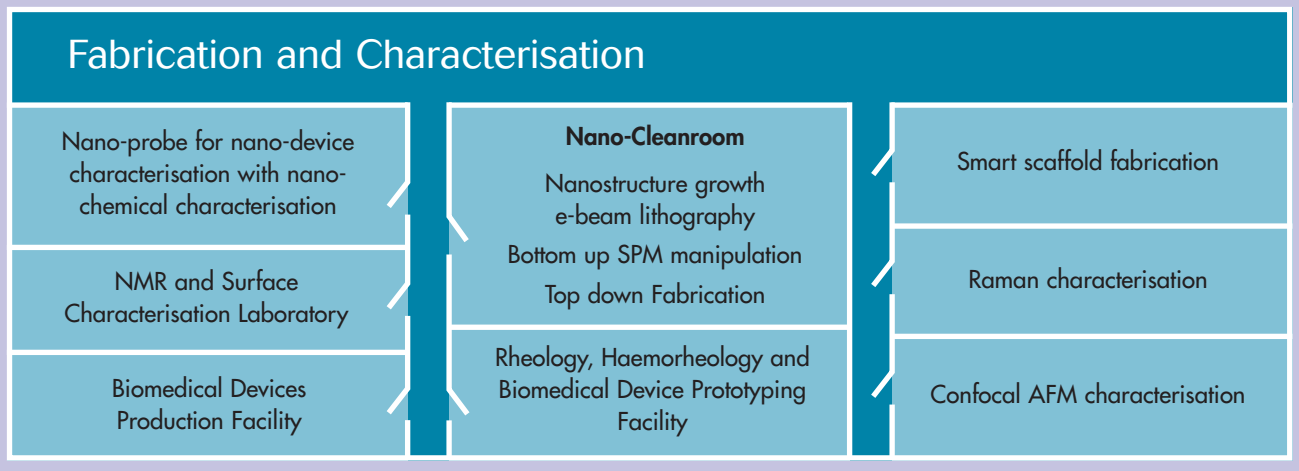
- Dedicated access for Business R&D
- Access to translational activities
- Access to patients through a clinical research unit
- 2000-2500m^2 floor plan
- State-of-the-art nano-cleanroom
- Top-down and bottom-up fabrication facilities including electron beam lithography and a non-standard scanning probe microscope.
- Direct linkage with a category 2 bio-environment
- Printing and production of devices, sensors and lung tissue
- Bio-discovery and production facilities, from nano-sensor bio-functionalisation to tissue engineering
- 10% of space reserved for business activity at the heart of driving research

Proposed floor plan

Floor A



Floor B



An Invitation to Business

Swansea University is seeking major strategic partners to help develop and drive the CNH research and commercialisation programme. In addition, smaller organisations are welcome to discuss joining collaborative research programmes.

CNH is seeking public and multi-national private sector partners with long term goals in the NanoHealth sector. The Centre aims to develop common R&D roadmaps with leading healthcare organisations.

Such partners will gain access to academic expertise for research and development, and will work together on disruptive technologies through to commercialisation. CNH is seeking to build a portfolio of intellectual property with its partners and will generate substantial licensing opportunities and new spin-out companies.

Reasons to Invest in CNH

Investing or locating within CNH offers:

- Access to environment for non-standard R&D for interfacing nanotechnology with bio-clinical sciences
- Access to expertise in nanohealth
- Access to Clinical Trials facilities and a large patient base
- Collaborative projects directed at short-, medium- and long-term impact
- Access to incubation space at the heart of driving research
- IP development and licensing
- Access to enhanced Blue C supercomputer

Contact the executive team on +44 (0)1792 295594, or email nanohealth@swansea.ac.uk if you would like to find out more about the project.

Maximising funding opportunities

The European Union has set itself the goal of becoming "the most competitive and dynamic knowledge-based economy in the world" as part of the 'Lisbon Agenda'. This agenda complements the Welsh Assembly Government's (WAG) strategy for economic development, and is reflected in the plans for use of the next round of European Structural Funds.

Parts of Wales continue to face economic challenges and consequently will qualify for economic assistance worth £1.2 billion, now known as 'Convergence Funds', during the period 2007-2013. The WAG strategy seeks to promote a high value–added economy by improving knowledge and innovation for growth, fostering research and development, innovation and technology and its commercial exploitation.

As a leading research-led University in the convergence funding region, Swansea University will help achieve these objectives by assisting in the development of enterprise and innovation. To achieve this it is planned to capture further major investment in its NanoHealth technologies and to build capacity for their commercial exploitation. This will be achieved by accessing convergence funding in partnership with public and private sector organisations. The convergence funding will help create significant opportunities and assistance for large or multi-national organisations wishing to access and commercialise the world leading NanoHealth research activities at Swansea University.

The University has a history of success in obtaining external funding through identifying suitable proposals: prior to the introduction of convergence funding, the University harnessed significant EU Objective 1 funding to the value of £21m.

The Centre will be a springboard to launch bids for substantial collaborative projects funded from a range of government and charitable sources.

Centre for NanoHealth - Executive Team

Professor Steve Wilks
Co-Director CNH

Dr Steve Conlan
Co-Director CNH

Dr Tim Claypole
School of Engineering

Professor David Gethin
School of Engineering

Professor John White
School of Medicine

Professor Rhodri Williams
School of Engineering

An attractive location

Swansea is located in a beautiful part of Wales, nestled on the edge of the Gower Peninsula. The University is just 3 hours from central London by train and 50 minutes from Cardiff International airport, which offers connecting flights to all major international cities. It is anticipated that the Centre for NanoHealth will be located in a new building on the Singleton Hospital site adjoining the University Campus, which is located one mile from the city centre.




Dr Chris Wright
School of Engineering

Jim Abbey
Institute of Innovation

Paul Holland
Institute of Innovation

Professor Javier Bonet
Head of School of Engineering

Professor Julian Hopkin
Head of School of Medicine

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