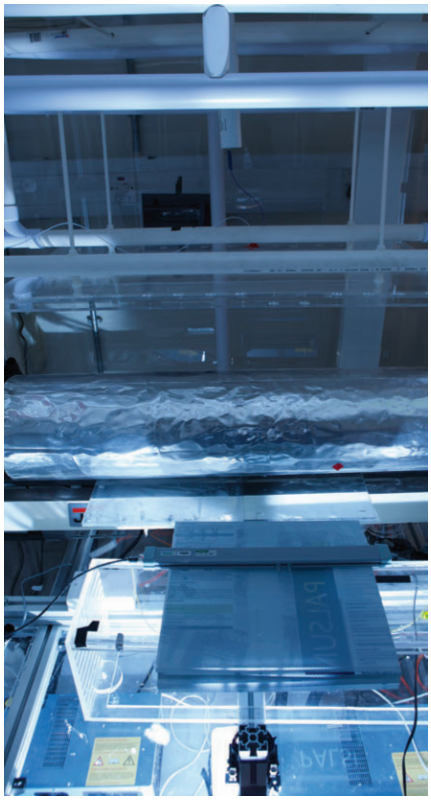
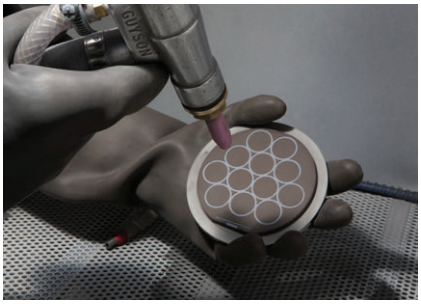
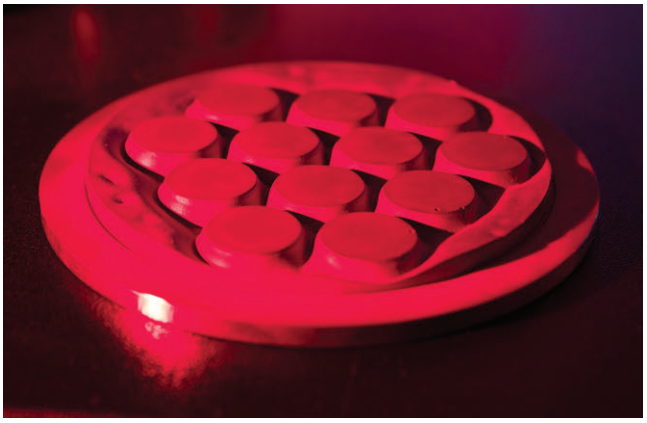
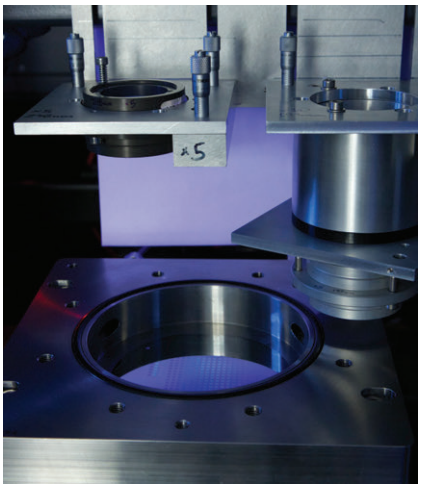
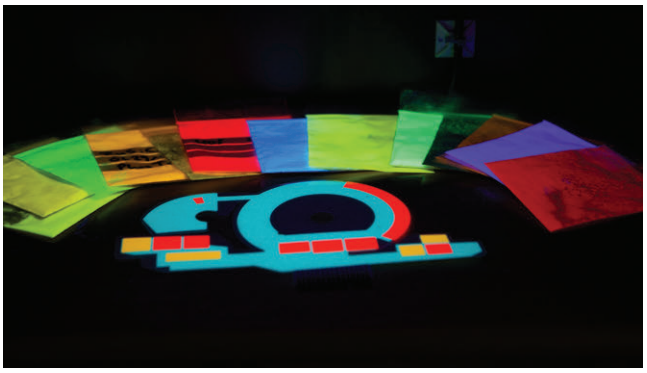
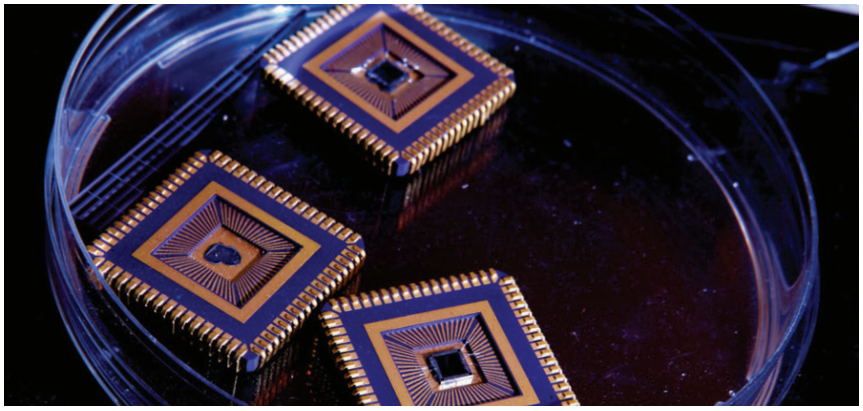
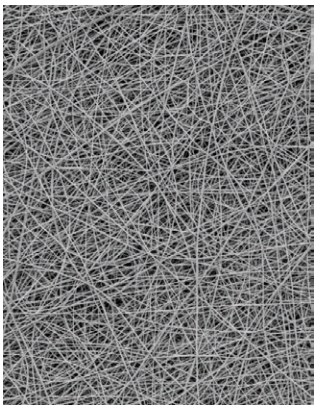
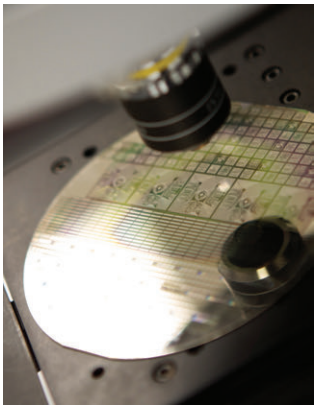









Working with Innovations in Surfaces, Materials and Related Technologies

iSMART

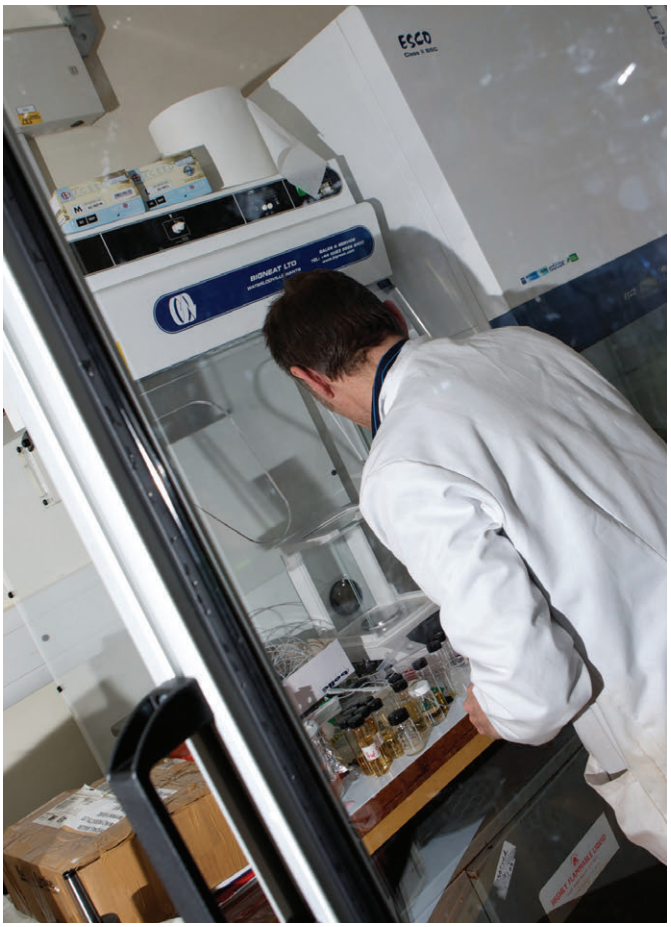
NOTTINGHAM TRENT UNIVERSITY

What is iSMART?

Nottingham Trent University has established iSMART to provide the manufacturing and advanced materials industry with the facilities, expertise and resources to assist with innovation, research and development of surfaces, materials and related technologies.

How can iSMART help your organisation?

iSMART is a multi-faceted project which aims to work collaboratively with established businesses to improve skills, generate income and create jobs and entrepreneurial opportunities in the rapidly expanding field of smart technology. If you have an idea for a product, want to improve manufacturing processes, or provide a cost-effective solution to a problem, then iSMART could help.



iSMART can provide you with:

Access to funding

NTU has a specialist grant capture team who can help your organisation gain access to valuable funding for research and development of your ideas and products.

Industry related training, research and expertise

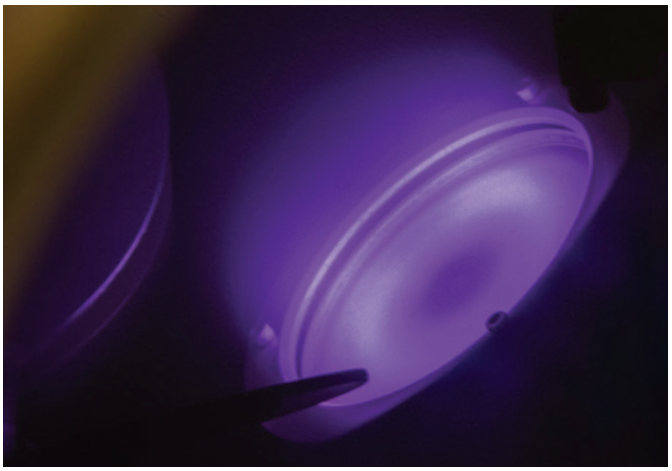
Our team of iSMART specialists has relevant, up-to-date, practical industry experience and research skills and can work with you to develop your ideas, or to provide your team with the skills and knowledge to support your own innovation strategies.

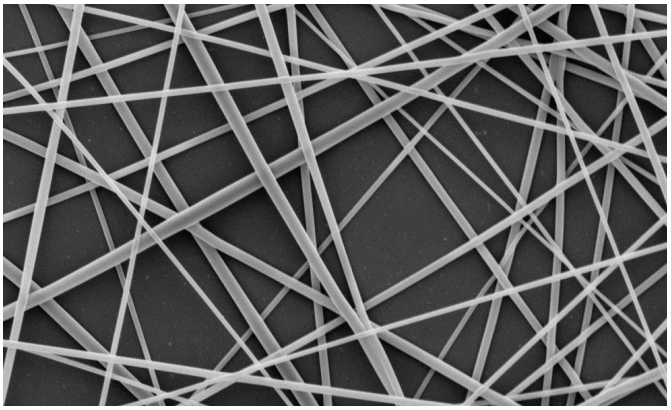
Assisting start-up and spin-out companies

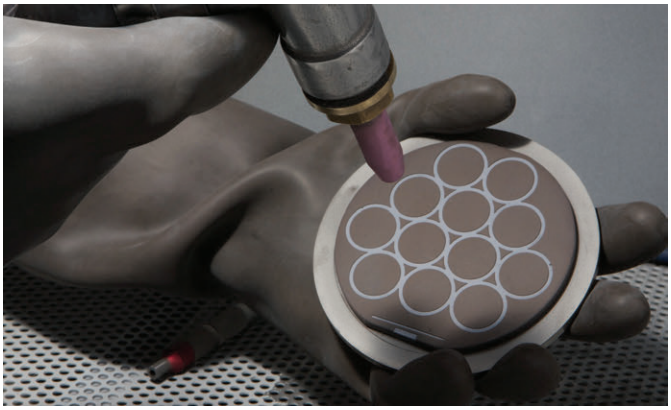
The iSMART team has close relationships with a number of specialist East Midlands incubation hubs, including BioCity, MediCity and Inntropy. Not only can we assist with researching and developing your ideas, but also with taking the first steps to building a thriving business in a vibrant and supportive scientific community.

State-of the-art equipment and facilities

The iSMART research facility is fully equipped with some of the very latest technologies:







iSMART assistive technologies

Electrospinning facility

This technique uses electrical charge to draw out solid fibres from a liquid solution. It does this by charging the body of the liquid and stretching the droplets until a stream of liquid is forced from the surface, forming a charged liquid jet. The liquid jet is then subjected to the electrospinning process, dried and collected. The stretching, spinning and thinning process results in the production of uniform fibres with micrometer and nanometer scale diameters.

Fibre properties

A wide range of natural and synthetic nanofibres can be created using the electrospinning process. The resulting fibres have beneficial properties with potential for applications in a wide range of industries.

Unique properties include:

- Nanoscale diameters 50nm to 10µm
- High surface area to volume
- Open porous
- Core and core-shell
- Aligned and random (non-woven)
- Conducting or insulating.

Nanofibres can be produced in a variety of formats including flat sheets, tubes and suspended membranes. The fibres can be doped with dopants, biomolecules, and nanoparticles to form functional composite materials.

Industry applications

The high surface area to volume properties of electrospun fibres make them suitable for activities and applications that have a high degree of close physical contact, such as providing porous fibrous plates for chemical and biochemical reactions to take place, or for filtration techniques. The spun fibres are practically free of defects and this property opens up the possibility of manufacturing mechanical performance nanocomposite materials. There is also potential for utilising these fibres in the manufacture of protective clothing and other non-woven textiles where a degree of breathability is required.

However, due to the scale of these fibres, some of the most exciting and innovative potential applications exist in the medical industry, in areas such as components for artificial organs, tissue engineering, enzyme and antibody immobilisation, implant materials, drug delivery and wound dressings.

Thin films research

Our team of experts can also provide expertise in the research and deposition of thin film materials for the development of new and innovative devices for use in a multitude of applications and sectors. Thin film deposition processes are complex and rely on using well maintained high cost coating systems and access to surface and thin film analysis tools. Overall, delivering a high quality coating requires a high degree of skill. NTU has a variety of assistive technologies for materials processing and coating which are applicable across a broad range of industrial applications:

Thin film deposition

Using radio frequency RF–magnetron sputtering, multi-layer coatings up to two microns thick can be applied to a whole spectrum of organic and inorganic substrates. Three multi-electrode RF magnetron deposition systems allow many different target materials and a range of process parameters to be tested to produce coatings which meet demanding technical specifications. The iSMART team has in-depth knowledge of how the process parameters influence the quality of the deposited thin film.

Thermal evaporation of metals

This process involves heating solid metal pellets or wire with an electrically powered tungsten filament inside a vacuum chamber to a temperature which generates a plume of metallic vapour within the chamber. The configuration on the system ensures the vapour stream is aimed at the substrate to be coated. In general the substrates are rotated and translated through the plume of metallic vapour to create uniform metal films with reproducible electrical and optical properties.

Spin coating

This is used to coat photosensitive polymers and photoresists onto glass and silicon substrates. A wide range of liquid formulations can be transferred into uniform thin coatings using this approach. It is an essential technology for producing microscale devices, microfluidics and micromachines.

Luminescent Materials

iSMART has a strong background in thin film luminescent materials, coating techniques and post deposition treatments to create efficient materials for emissive displays, thermographic sensors and anti-counterfeit devices.

Plasmonic Thin Films

Nanoparticles of metals, rigidly attached to a surface or embedded in dielectric thin films offer unique optical properties and great potential in a variety of applications like SERS, photovoltaics, decorative coatings, non-linear optics, security, cryptography, optical data storage, or light out-coupling to name a few. Expertise within iSMART includes the fabrication of such thin films with optical response that can be tuned in wavelength and amplitude.

Laser processing and precision cutting

Excimer Laser processing

High powered ultraviolet pulse lasers are used on a daily basis in iSMART to process thin films and bulk materials to create microscale devices and nanoscale structures for a range of high value applications. iSMART has two dedicated excimer laser systems. One is an Argon Fluoride laser which emits 193nm laserlight and the other is a Krypton Fluoride laser which emits 248nm. Each is equipped with homogeniser optics to create a uniform beam profile which is used to project a masking pattern via a number of mirrors and lenses onto the substrate to be processed.

The lasers can be used for large area or precision processing, with minimal effect on the underlying substrate. This means that delicate, high value and in-situ substrates can be processed safely and effectively. Typical laser processing applications include:

- crystallisation;
- surface sintering and densification;
- surface texturing;
- etching through holes, cavities and channels; and
- segmentation to produce small structures and microscale substrates.

YAG Laser

iSMART has a Continuum YAG pulsed laser system which can be configured to produce 1064nm, 532nm, 355nm and 266nm laser light. Additionally an Optical Parametric Oscillator (OPO) unit allows for the provision of laser light covering almost the whole spectrum from 400nm to 1000nm. Homogeniser and attenuator optics and a wide range of delivery and collection optics allow analysis of functional optical materials and modification of many others to be conducted quickly.

Fibre coupled Diode Laser Module

Many healthcare, defence and industrial applications have adopted semiconductor laser modules to provide reliable, compact, high power laser sources. iSMART has invested in a 50W, 980nm fibre coupled laser module and focusing optics to provide a versatile source to allow processes to be developed which will deliver clean, high speed welding of plastic components for medical devices.

High Power Ultraviolet Lamp

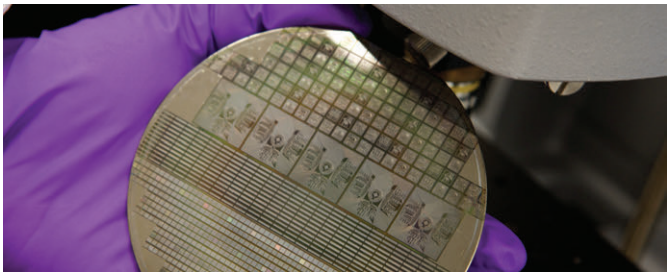
iSMART has a 30cm, 172nm Excimer Lamp system. With high-energy UV light, water, air and surfaces can be reliably sterilised, cleaned and treated. The use of chemicals can be reduced or even avoided. In comparison with other technologies, UV light is an economical and environmentally friendly alternative which is increasingly used in many industries.

Powder blasting

This is an extremely versatile cutting technique which can be used to cut or modify the surface of a broad range of materials. iSMART specialises in the tailoring of electronic devices out of silicon, quartz and sapphire. These materials are coated with a photo-resist and exposed under UV using a mask of defined dimensions, according to the project of interest. The exposed region is then powder blasted away to leave the required shape on the wafers. Many particles can be used for this process including alumina, silica and tungsten carbide, all at a specific particle size depending on the resolution required.

This method is used to microstructure the surface of virtually any brittle materials and has the potential to create innovative products in multiple sectors, including:

- healthcare: IVD diagnostics and detectors;
- energy: fuel cells, micro-reactors and harsh environment sensors;
- environment: chemical processing and lab-on-a-chip; and
- defence: sensors, actuators and detectors.



Microscopy

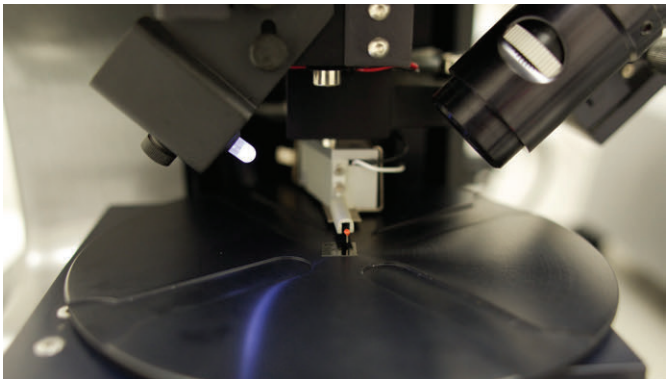
Electron microscopy

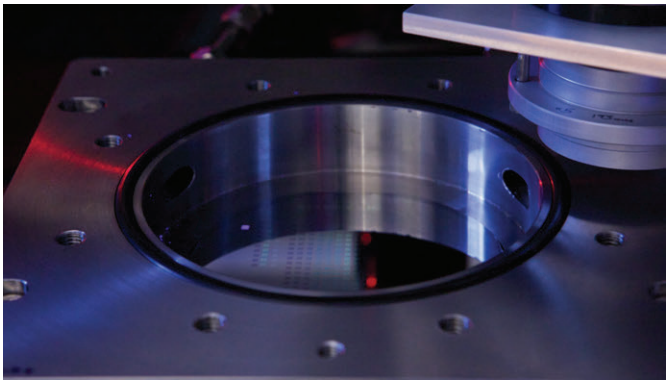
iSMART has a Phenom ProX desktop scanning electron microscope. It is the ultimate compact all-in-one imaging and X-ray analysis system. With the Phenom ProX desktop SEM, sample structures can be physically examined and their elemental composition determined. Viewing three-dimensional images of microscopic structures only solves half the problem when analysing samples. It is often necessary to collect more than optical data to be able to identify the different elements in a specimen. This is accomplished in the Phenom ProX with a fully integrated and specifically designed EDS detector.

EDS is a technique that analyses X-rays generated by the bombardment of the sample by an electron beam and EDS elemental analysis is fully embedded into the Phenom ProX system.

Metrology

To support the development of optimal processing techniques, iSMART has a dedicated clean room with optical microscopes with high resolution cameras for digital picture and video capture. A white light interferometer system allows 3D profiling of surfaces. This is supported by a stylus based profileometer for physical measurement of step edge and surface roughness. In addition, iSMART has access to a fibre coupled spectrometer for thickness measurement of transparent thin films.





How you can support iSMART

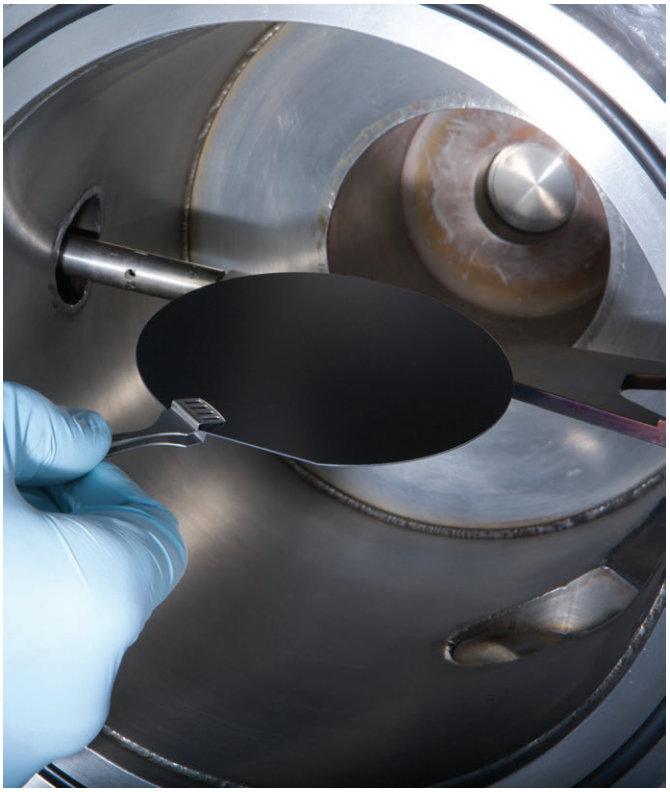
Only by working together can we create the required skills and job opportunities to ensure the continued development and future prosperity of the UK advanced materials and high value manufacturing industries. NTU is committed to providing graduates with the right skills for modern industry and we are always looking for partners to provide employment and research opportunities for our students.

Provide a work placement

We have high quality undergraduate students who are looking for work experience in a relevant industry to help embed the knowledge gained through their course of study. By offering a short term, or year-long work placement, your organisation gains a valuable and knowledgeable member of staff with up-to-date knowledge and skills – you also get your pick of the best students before they graduate.

Offer a postgraduate research project

If you have an idea for a new product or process, but lack the internal resources to carry out the research, you might consider employing an NTU postgraduate student to help with your research. Our students, trained on the latest equipment and with access to our superb facilities, can undertake your research project, supported by a member of our academic team.



Contact details

If you would like to find out more about iSMART or talk to us about a specific project, then please get in touch

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