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Melbourne Centre for Nanofabrication

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Industry looks to partner with MCN in R&D

MCN has become a regular feature of the Small Technologies Industry Uptake Program (STIUP), having been part of seven successful applications totaling a combined value of approximately $750,000.

The Victorian government funded STIUP initiative assists Victoria's innovative small technology companies with the cost of access, consultation and R&D services provided by state-of-the-art facilities such as the MCN.

The latest entry into STIUP is Aqua Diagnostic; a small Melbourne-based water management company.

Aqua Diagnostic fabricate chemical oxygen demand sensors (PeCOD®) which provide reliable analysis of water sources. Their flagship PeCOD® sensors assess water quality by detecting organic compounds, such as pollutants in surface water.

Through STIUP Aqua Diagnostic is looking to develop and implement an automated sensor production process, capable of producing PeCOD®sensors in commercial volumes at high quality.

To do this, Aqua must first identify the critical specifications required during the manufacturing process of the PeCOD® sensors.

By using specialised services and established equipment, MCN will investigate the key characteristics such as crystalinity, particle size, surface area, porosity, thickness and surface chemistry of the PeCOD® sensors. Assessing the characteristics of effective sensors will provide insight into the failure mechanisms and causes of reductions of performance of the devices in service.

This knowledge will then be integrated into both the optimisation of the manufacturing process and the fundamental understanding of the sensor operation.

This information will be used by Aqua to implement a cost effective characterisation system for ongoing quality control within the manufacturing process.

MCN has supported companies such as Grey Innovation, Biodetectors Ltd, and Liquitab, by improving on existing designs, providing consultation services for novel ideas, or determining the feasibility of new projects. For more information on the STIUP program, visit http://goo.gl/PZ9GZ.

In this edition....

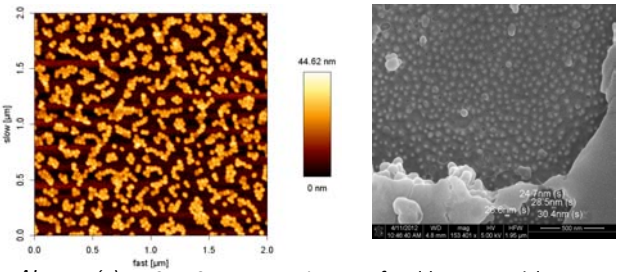
Characterisation of gold nanoparticle surface assemblies

Surface plasmon resonance (SPR) can be described as the resonant, collective movement of electrons activated by incident light that travels in a direction parallel to a surface. When two nanoparticles are placed in close proximity, the electric field is greatly enhanced creating a "hot spot". These hot spots are of particular interest to researcher Soon Ng, of Monash University. Working collaboratively with Instrument Manager Matteo Altissimo, Soon is manipulating these electric field "hot spots" to increase the sensitivity of his biosensors.

The JPK Nanowizard II AFM at the MCN was used to accurately measure the height of the particles as well as the overall topography, as shown (see right). One of the key features of this instrument is that it allows imaging in both air and liquid.

Additionally, the FEG-SEM is used to measure the size of particles and to aid in the calculation of surface coverage. Future work on this project will utilise the Electron Beam Lithography to create templates for nanoparticle absorption in order to study the spatial configurations related to the hot spots. As well as having applications in biosensing, chemical detection and solar cell technologies, the properties of surface plasmon resonance may be used during characterisation and imaging processes.

This is an example of a project where multiple capabilities available at MCN were used in sequence and assembly and characterisation. For more information on how to incorporate nano characterisation into your research project please contact Dr. Matteo Altissimo (matteo.altissimo@monash.edu)



Above: (a) A 2 x 2 µm AFM image of gold nanoparticles on a flat substrate. *(b)* SEM micrograph showing measurements of nanoparticles under a polymer film.

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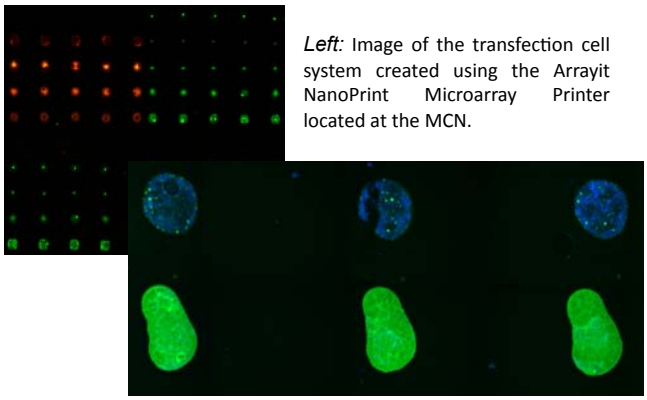
Is high throughput screening relevant to you?

Research areas that involve time consuming and repetitive processes may benefit by adopting new experimentation methods which involve efficient screening.

Incorporating nanosystems into experiments can also provide useful insight into the interaction of nanomaterials within the biological environment, gene expression, targeted cell delivery and encapsulation.

Michael Nastasie, a researcher from Monash University is working in collaboration with MCN Biology Lab Manager Varsha Lal to design a novel process capable of conducting a series of simultaneous nano-experiments within an automated array system. The idea is to observe the transfection of numerous known DNA constructs into specific mammalian cell populations.



Left: Image of the transfection cell system created using the Arrayit NanoPrint Microarray Printer located at the MCN.

Above: Close-up of Array spots. Protein Vectors are tagged with GFP NanoPrint Microarray Printer located at the MCN and appear Green. HeLa Cell Nuclei are labeled with DAPI and appear Blue. DNA areCy3 labeled and appears Red.

Transfection is the process of deliberately introducing nucleic acids (biological molecules such as DNA), into cells. Using the MCN's MicroArray system, the team can perform transfection experiments simultaneously using the high throughput capabilities of the microarray system.

According to Michael "the microarray system available at the MCN will be crucial in the ability to simultaneously test numerous different transfection solutions, on a large variety of surfaces, under controlled humidified conditions, with minimal user interaction." Since an array can contain tens of thousands of probes, the automation and concurrent nature accomplished by this MicroArray system drastically improves the efficiency of experimentation and accuracy of results.

The technology gives researchers the power to test large quantities of cells in concurrent experiments.

For more information on how to incorporate the MicroArray system into your research project, please contact Ms Varsha Lal (varsha.lal@monash.edu).

To view all the latest MCN training opportunities visit www.nanomelbourne.com/training

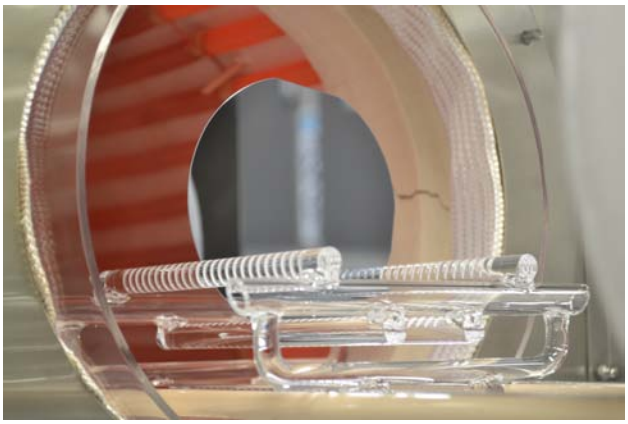
Equipment update….

Our new Hitech furnace

MCN has just completed the installation and commissioning of its new Hitech furnace. The furnace has two target functions, oxidation of silicon and annealing of samples. Whilst performing either of these operations, the furnace is required to reach temperatures in excess of 1200°C.

The oxidation process can be both wet (oxidation performed in steam environment generated by burning hydrogen and oxygen) or dry (using oxygen gas only). These techniques are useful in areas of device fabrication including isolating electrical regions of a device, forming microfluidic channels, oxide sharpening of AFM tips and creating ohmic contacts.

The newly installed furnace is capable of accepting 2 inch, 4 inch and 6 inch wafers and complements many of the existing cleanroom instruments and processes. For further information on the system please contact Doug Mair (douglas.mair@monash.edu).



Above: The new Furnace allows for the oxidation and annealing of silicon samples on a wide range of wafer diameters.

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Equipment Update….

Our new micro patterning lithography system

Above: The maskless micro patterning lithography system gives researchers the ability to rapidly fabricate micro features on a range of photoresist materials.

Installation of our Intelligent Micro Patterning (IMP) SF-100 XPRESS maskless lithography system is now underway and scheduled for completion in early July. The system enables researchers to rapidly fabricate micro devices and caters for a wide range of substrate sizes, materials, and shapes. Direct write micro patterning processes can be used to create polymer circuits, MEMS, microfluidic devices and sensors. The IMP system accepts a range of film thicknesses, without additional setup time or swapping of optical components. SU8 resist, a thick resist and a material commonly used for MEMS device fabrication can be processed in the standard configuration.

3D exposure settings are also available which allows the patterning of curved and non-flat substrates. Processing is rapid and enables the user to write designs directly for immediate testing and easy modification. The system also features high resolution optics capable of resolving features as small as 1 micron.

For more information on the micro patterning lithography system contact Sean Langelier (sean.langelier@monash.edu)

Our new electroplating tools

The new Electroplating suite has been installed and commissioned in the MCN clean room. The suite includes a nickel electroforming system (SA1000V) for growing nickel stampers, a passivation and cleaning station (EC 1000) and a gold electroplating system (PMT-16). The new equipment will allow the manufacture of nickel stamping tools similar to those used in the DVD mastering industry. Other applications include generating stamping tools for injection moulding, casting or other replication processes. The SA1000V can accommodate masters up to 200 mm diameter and is currently set up for 6” wafers or 5” mask plates. A typical growth rate is around 40 microns/hour giving researchers the ability to generate a master nickel stamper in less than a day. Any micro pattern including microfluidic devices can also be copied, metallised and replicated into a nickel tool using this machine.

Above: Anatoly Kuzmin from Digital Matrix calibrating the new electroplating system

The EC1000 system supports the SA1000V, and can be used for passivating and cleaning nickel stampers so they can be copied. During the cleaning phase, a thin nickel oxide layer is grown electrochemically on the stamper. This allows smooth release of the copy after electroplating has finished without any damage.

The new facility also includes a gold electroplating capability that can be used to generate nanostructures through a resist. The gold plating is a sulphite based system called techni-gold 25ES and is currently being tested. The new facility may be of interest to those wanting a hard production tool for fabricating nano-imprinted structures and will replace an older facility at CSIRO Clayton. It is expected to add significant new capability to the manufacturing arm of the MCN.

Image of the year

Submissions are now open for the inaugural MCN Image of the Year Competition. All users are eligible to enter for a chance to win a $200 dinner certificate at Enzo’s restaurant. There is no limit to the number of times that you can enter, nor on the theme for your images.

To enter the competition, forward your images and the submission form to mcn-enquiries@monash.edu. For full competition details and to download your copy of the submission form visit:

www.nanomelbourne.com/image-competition

Entries close by 31st October, 2012.

Featured publications

MCN staff and user community regularly feature their research in academic and industry based journals.

Recent highlights include a publication from Optics Express which featured in the top 10 most downloaded list for the month of May:

Nishijima, Y., Rosa, L., Juodkazis, S., *Surface plasmon resonances in periodic and random patterns of gold nano-disks for broadband light harvesting.* Opics Express, Vol. 20 Issue 10, pp.11466-11477 (2012)

To access this and other publications featuring MCN visit www.nanomelbourne.com/publications

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Nanoexperts host fabrication workshop

Above: *MCN Technology Fellow Professor James Friend discusses the applications of chemical and ion –assisted etching.*

In April MCN hosted an educational workshop open to members of the local nanotechnology and general science community. The event provided attendees with a basic introduction to nanofabrication techniques. The workshop commenced with a welcome from MCN Director Dwayne Kirk and featured presentations by three of the MCN Technology Fellows.

Dr Tim Davis, a Principal Research Scientist from CSIRO opened the first session with a presentation on photolithography and direct write lithography methods. Photolithography techniques are widely used as precursor in the development of microfluidic devices and biological sensors.

The next seminar was hosted by surface interaction specialist Professor Raymond Dagastine from The University of Melbourne.

Attendees became familiar with a variety of thin film deposition practices such as sputter coating, evaporation and atomic layer deposition for metals and insulators. Many areas of research such as medicinal and therapeutic research rely on such processes for chemical sensing, biodetection and plasmonics.

Professor James Friend from RMIT University concluded the technical presentations by calling on his expertise in applications of chemical and ion-assisted etching. These processes have been key to his team's own R&D projects, of which include drug delivery systems, MEMS devices and a range of mechanical and chemical sensors.

Guests were then given practical advice on how to access and incorporate similar nanofabrication processes into their own research projects. The afternoon concluded with attendees invited to join guest speakers and MCN staff for a facility tour, and encouraged to join spirited discussion regarding current trends, applications and the future direction of the nanotechnology industry.

Based on the success of the workshop, MCN plans to host a repeat session during February 2013. Details of the workshop will be released in the December edition of the newsletter and on our website.

Prepaid access for university researchers

Two major Victorian universities: The University of Melbourne and Monash University, have arranged for pre-paid access on behalf of their researchers to enable their use of the MCN.

In 2011 Monash University trialed a six month pre-paid access program for researchers, during which time, Monash doubled its monthly usage of MCN facilities. Beginning on June 1st Monash University has renewed its access program.

Similarly, the Melbourne Materials Institute (MMI) has organised a program to assist researchers from The University of Melbourne with initial training requirements and ongoing use of MCN equipment and facilities. For more information visit http://nanomelbourne.com/access or email your enquiry to MCN-enquiries@monash.edu.

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