MC NEWS
Melbourne Centre for Nanofabrication
DECEMBER 2013



IN THIS EDITION

FIB-SEM WITH 3 NEW CAPABILITIES

The FEI Helios NanoLab 600 Dual Beam FIB-SEM is one of MCN's highest utilised instruments due to the broad range of ultra-high resolution lithography and characterisation capabilities that it offers. To compliment the Kleindeik Nanogripper accessory which was installed earlier in the year (see MCNews October 2013), we now have three new accessories to further enhance user capabilities.

1. QUICK LOADER CHAMBER

The Quick Loader is designed to load regular 12.55mm to 32mm samples into the specimen chamber via a chamber port which does not require the working vacuum to be broken. This means exchange times will be 30 times faster than currently possible, allowing samples to be exchanged in less than a minute. It will also allow for a cleaner working environment for electron optical work.

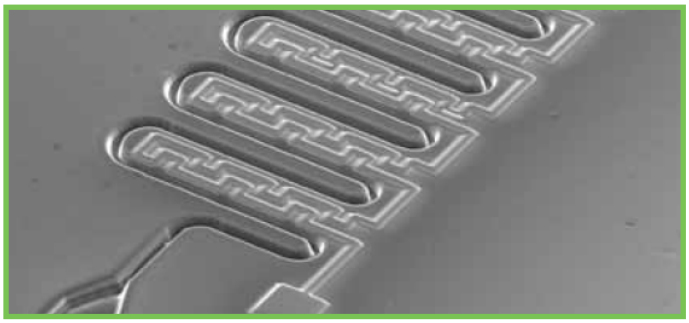
The loading and unloading cycles are also simplified through software which automates the staging location for samples.

2. NANOBUILDER SOFTWARE

The Nanobuilder software is a 3D nano-prototyping application which allows users to design and create complex multi-layer nanostructures which are currently not possible or too time intensive to undertake. It offers high resolution large scale patterning and precision ion beam control.

Users are able to assign different processes to individual layers of the design and define the sequence in which the Nanobuilder executes these.

The software includes automated beam alignment and drift control, to ensure that the layers are aligned with high accuracy to mitigate the chance of unwanted exposure of the pattern area to ions or electrons. This software is unique to MCN within Australia.



A nanofluidics building block created on the FEI NanoLab600 Dual Beam FIB-SEM with the Nanobuilder Software. Image courtesy of FEI

3. METAL-ENHANCED GAS INJECTION SYSTEM

The metal-enhanced gas injection system will enhance the etch rate and shorten the milling time for FIB Lithography of metals and silicon nitrides. These processes are typically efficient for small areas of lithography only as large areas are highly time consuming and are susceptible to pattern distortion. FIB Lithography also tends to be limited to low aspect ratio structures, as when the milling depth increases sputtering on the side walls can occur. The gas injection system alleviates both of these limitations as it will speed up milling of large areas and prevent sputtering on sidewalls and surrounding structures.

For more information, please contact
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NOTABLE PUBLICATION!

Recently published in the prestigious Nature Communications journal, ***Bactericidal Activity of Black Silicon*** looks at the bactericidal effects of silicon nanostructures in the development of a new generation of mechano-responsive, antibacterial nanomaterials.

Authors: E.Ivanova, J. Hasan, H. Webb, G. Gervinskas, S. Juodkazis, V,Truong, A. Wu, R. Lamb, V. Baulin, G. Swatson, J. Watson, D. Mainwaring, R. Crawford.
Visit **http://nanomelbourne.com/publications** to read more.

MICROSENSORS TO MONITOR BLOOD PRESSURE

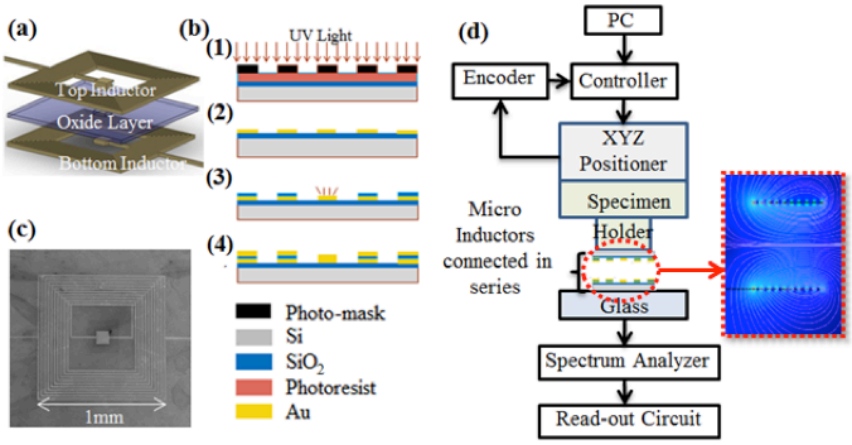
Hypertension, if left untreated, can lead to a number of health problems including strokes, heart failure and kidney failure. Regular monitoring of blood pressure is currently inefficient and is not performed as regularly as necessary to monitor and mitigate these serious health concerns.

Researchers from Monash University, led by Dr Tuncay Alan, are developing a highly sensitive, implantable blood pressure sensor. These micro-sensors could be implanted into patients suffering high blood pressure to better monitor levels. The sensors would allow continuous and routine blood pressure measurement and the reading would then be communicated wirelessly to a hip-held alert unit. The results could then lead to earlier diagnostics of related diseases, complications and more efficient treatment.

The devices being investigated by Dr Alan and A/Prof Adrian Neild in the Laboratory for Microsystems, are inductor sensors which are far more sensitive when downscaled than other sensors which have previously been researched. The team have developed a model which uses two planar spirals separated by an insulating layer, and have fabricated the double layered microplanar coils at MCN. The opposing magnetic fields between pairs of these coils create a high sensitivity to relative displacement which can be linked to pressure.

Results so far show that device dimensions could be shrunk for further improvements on resolution. Overall results suggest that inductive sensing has a good potential for micro scale sensing applications. Collaborators are currently investigating the circuitry necessary for the sensor and the fabrication of a complete system.

You can read more about this project in a paper by the team: **Nanoscale displacement sensing using microfabricated variable inductance planar coils.**



(a) An exploded view of the double layer planar micro inductors is depicted,
(b) summary of the fabrication steps:
(1) Oxide deposition and UV Lithography,
(2) E-beam evaporation and lift-off.
(3) SiO 2 deposition and etching.
(4) Steps 1–2 repeated for the second inductor layer
(c) a scanning electron micrograph of the resulting coil.
(d) monitor design.

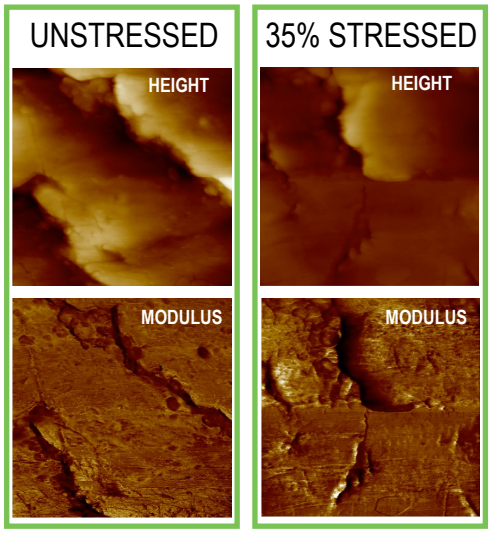
NEW AFM CAPABILITY: PFQNM

MCN now has a new capability to augment the Bruker Atomic Force Microscope in our class 10,000 Clean Room - Peak Force Quantitative Nanomechanical Property Mapping (PFQNM).

PFQNM is a ground-breaking Imaging Mode that allows the mapping of material properties such as modulus, adhesion, surface deformation and energy dissipation, while also imaging the surface topography of a material in high resolution.

The Peak Force Tapping technology works to precisely control the forces applied through the cantilever tip to the sample so that indentation is minimal and the sample remains undamaged, while receiving a high quality end product. This means that even the most delicate biological samples can be imaged.

This is particularly useful for the exploration of mechanical properties of cells and tissues, polymers, composites and hydrogels as well as plant morphogenesis and nanomaterials embedded in biologics. For more information, please contact **hemayet.uddin@nanomelbourne.com**

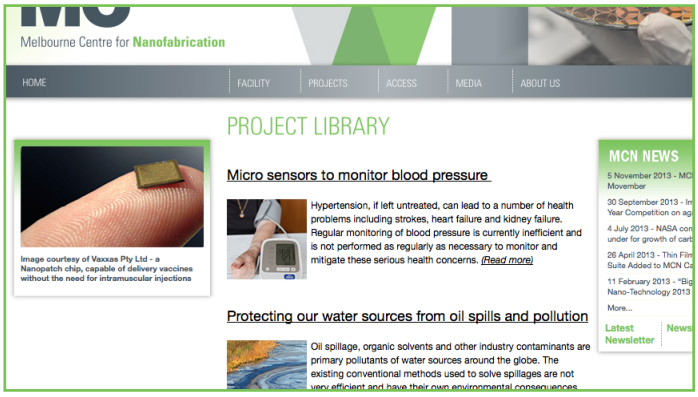


Images: Modulus maps (bottom) of horse-hair with and without stress. With 35% tensile stress the Yang modulus increases ~140%.

PUT YOUR RESEARCH IN THE SPOTLIGHT

We would like to invite all users highlight their research through a series of case studies to be featured on our website and newsletter! This is a wonderful opportunity to showcase the valuable research you have undertaken at MCN to a broad audience of engaged readers.

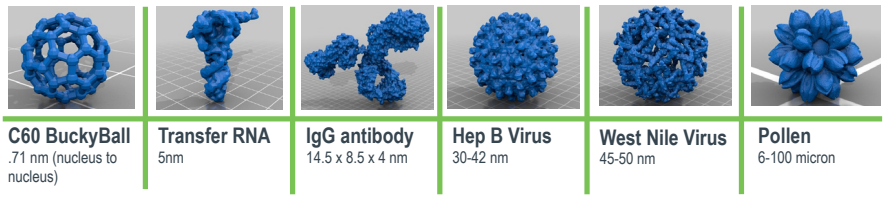
A case study template can be found on the MCN website - **www.nanomelbourne.com/projects.** If you would like your work to be showcased, please fill this in and send it to **sarah.abramson@nanomelbourne.com**.



SPIE CLOSES 2013 WITH A BANG

Last week saw over 200 delegates meet at the SPIE Micro+Nano Materials, Devices, and Applications Conference at RMIT in Melbourne. With experts from around the world presenting on nanofluidics, plasmonics, solar energies, MEMS and phototonics, the conference was a valuable meeting of the minds and an excellent way to finish up 2013.

MCN based projects featured heavily on the presentation program and as sponsors of the conference, MCN staff and Technology Fellows chaired several sessions. Our booth was a hive of activity with delegates participating in our "Which Particle Am I?" Competition, which asked them to both correctly name a range of particles and place them in size order. Thank you to all of our participants and congratulations goes to our winners Wenlong Cheng and Lorenzo Rosa! The answers can be seen below.



C60 BuckyBall	Transfer RNA	IgG antibody	Hep B Virus	West Nile Virus	Pollen
.71 nm (nucleus to nucleus)	5nm	14.5 x 8.5 x 4 nm	30-42 nm	45-50 nm	6-100 micron

Images from top left clockwise: CSIRO Post Doc at MCN, Dr Florian Lapierre presenting on how to fabricate robust microfluidic systems for $1; participants playing the "Which Particle Am I" competition at the MCN booth; Dr Timothy James from the University of Melbourne presenting on Vanadium dioxide thickness effects on tunable optical antennas.

SAVE THE DATE!

2014 SEMINAR SERIES

MCN will be kicking off 2014 with a brand new seminar series where we will be bringing you insights from our industry clients, Technology Fellows, PhD students and users!

You don't want to miss these amazing sessions so save these dates in your calendar! Keep an eye on the **events page** of our website for more details to come!

FRIDAY MARCH 28 2014
9AM - 12:30PM

MCN's Tech Fellows: a collaborative approach to nanofabrication.

TUESDAY APRIL 29 2014
9AM - 11AM

How the minute can make a monumental difference in medical bionics.

THURSDAY MAY 29 2014
9AM - 11AM

Nano R&D in Victoria's private manufacturing industry.

THURSDAY JUNE 26 2014
9AM - 11AM

A PhD frenzy: the next generation of innovation .

HAPPY HOLIDAYS

MCN would like to wish all of our colleagues and friends a safe and joyful holiday season! 2013 has been a wonderful year for MCN and we look forward to sharing an even better one in 2014.

MCN will close on **Friday 20th December** and reopen **on Monday 6th January.** There will be no laboratory access during this time.

MCN PROUD TO SUPPORT MOVEMBER

MCN held a six-strong team this Movember with staff members Eugeniu, Hemayet, Lachlan, Sean, John and Dwayne growing moustaches throughout the month of November to raise awareness of men's health issues such as prostate cancer. The team is pictured below at the start of Movember, as well as at a fundraiser morning tea in the final week.

All manner of delicious mo-themed goodies were baked by staff members to further fundraise for the team. We are pleased that over $1000 was raised over the month and thank everyone who contributed to this very important cause.

ANFF SHOWCASE A SUCCESS

Staff and users from ANFF facilities all over Australia gathered in Melbourne in November to showcase their latest work, discuss new techniques and network.

The two day workshop saw presentations on a range of topics from metal assisted etching of silver solar cells to using microfluidics to isolate rare blood cells.

MCN Technology Fellow, Professor Tim Davis of CSIRO presented his work on plasmonic circuits for optical signal processing at subwavelength scales, highlighting the vital role MCN and our staff have played in this research.

Technology exhibitors were also present to display their latest innovations and instrument updates, providing a valuable industry update for all attendees.

Image: Professor Tim Davis presenting at the ANFF two day workshop in November.