Australian National Fabrication Facility
ACT Node & WA Node
NEWSLETTER
September 2015 - Issue No. 25

In Focus - Barrel Etcher

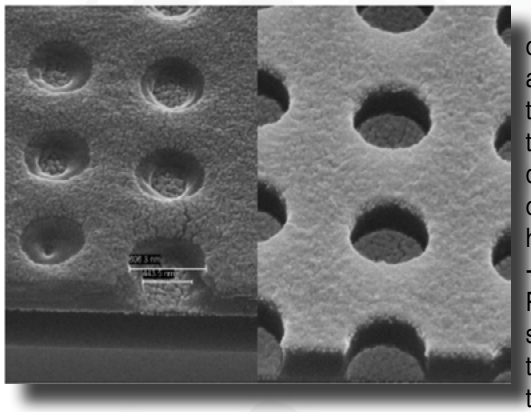


Figure 1- Footage removal benefit is obvious in above right photograph showing a well-defined pattern vs left photograph without any O_2 plasma treatment.

Continuing our new series of articles focusing on tools available at the ACT Node, this quarter we look at one of the work-horses of our labs - the Barrel Etcher. Part of our suite of small processing tools purchased to supplement the 'flagship' tools, under the direction of the Node Manager Dr Fouad Karouta, this benchtop barrel etcher enhances the Node's micro- and nano- fabrication capabilities. The Barrel Etcher is a simple tool using relatively high pressure plasma (generally O_2) to remove organic materials and residues from samples and wafers while keeping damage to minimum levels.

A number of 'standard' processes have been developed in-house to match tools and materials used by our users. One of the first developed was a short, soft O_2 plasma process termed 'footage removal' – a process to enhance pattern definition after e-beam lithography (EBL) and optical lithography – as shown in Figure 1 above. This is used mostly for removal of positive resists such as PMMA and ZEP used in EBL, or applied to positive resists used in optical lithography. Another process was developed to remove organic resists that had been exposed to Cl_2 or ion irradiation that hardens the resist making it non-dissolvable in acetone. In this case high power O_2 plasma is the only choice to remove this hardened layer.

Another important application considered at purchase required the fitment of a second gas line supplying CF_4 – III-V semiconductor nano-wires (NW) used in device applications. This technique involves planarising the NW sample with benzo-cyclo-butene (BCB) and etching back the polymer with both CF_4 and O_2 to uncover the NWs and finally depositing a metal electrode for electrical contacting – hence the two gas lines.

Fouad was also interested in developing an O_2 process to remove chromium (Cr), a metal often used as a SiO_x etching mask for high aspect ratio structures. Certain Cr oxides are volatile but only at high pressures (around 1 mBar) so the barrel etcher was retrofitted with a butterfly valve to facilitate the pressure increase. With this addition it is possible to fully remove a 50nm Cr layer using purely O_2 plasma in about 30 minutes. This process is highly selective of other materials like SiO_x, Si and III-V semiconductors.

One final benefit of the system is the ability to run processes using a Faraday cage to further reduce ion bombardment of the sample during the plasma process.

Please contact our staff if you think the barrel etcher can be useful to your research or device development.

2015 New Scientist Eureka Prizes

Established in 1990 to reward outstanding achievements in Australian science and science communication the Eureka Prizes are Australia's most comprehensive national science awards. The New Scientist Eureka Prizes are a unique partnership between government organisations, institutions, companies and individuals committed to Australian science. Presented annually by the Australian Museum in partnership with sponsors and supporters, the prizes reward excellence in the fields of:

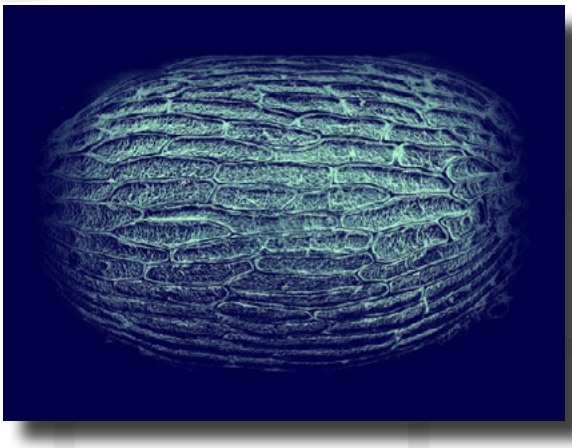
- research & innovation
- leadership
- school science
- science communication & journalism

This year ANFFL CEO, Rosie Hicks, is a finalist in the CSIRO Eureka Prize for Leadership in Science along with Professor Snow Barlow (University of Melbourne) and Professor Michelle Simmons, (University of New South Wales). Rosie's nomination reads:

"Rosie Hicks is the CEO of the Australian National Fabrication Facility, which links 19 universities and CSIRO to create a national collaborative research network with over 550 tools. She has gathered the best of Australia's fabrication expertise to deliver outstanding outcomes in a transformative area of science, technology and industry."

I believe another university can now be added to the list to make it a round 20 univerities plus CSIRO. Winners will be announced at the Award Dinner on 26 August 2015 - let's wish Rosie the best of luck!

Also, in the category of 'New Scientist Eureka Prize for Science Photography' in the same awards the ACT Node, along with the Australian National Botanic Garden's (ANBG) Seedy Volunteers, were awarded a 'highly commended' citation for the image below. Titled *'Another planet: Epacris paludosa (Alpine Heath) Ericaceae'* Dr Fanny Karouta-Manasse, from ANBG's Seedy Volunteers and Dr Mark Lockrey (ANFF ACT) produced this image using our new FEI Verios SEM-CL that featured in our last newsletter.



"Much like discovering another planet, imaging can reveal the intricate form of tiny plant seeds, and this idea inspired the Seedy Volunteers' image. The National Seed Bank aims to store living seeds for tens to thousands of years for the conservation and research of native plants, and this seed (0.53 mm in length) is one of them." Dr Karouta-Manasse said.

See more details at:
http://australianmuseum.net.au/2015-finalists-eureka

Image courtesy of Seedy Volunteers.

More awards!

ANFF ACT Node Director, Prof. Chennupati Jagadish was in Rome recently to receive the IEEE Nanotechnology Pioneer Award *"For pioneering and sustained contributions to compound semiconductor nanowire and quantum dot optoelectronics."* On the IEEE Nanotechnology Council website (http://sites.ieee.org/nanotech/2015-ntc-award-winners-announced) it goes on to say:

"Professor Jagadish has established a world-class research program on compound semiconductor optoelectronics and nano-technology. Key among his accomplishments are a number of major advances in compound semi-conductor quantum dot and nanowire growth techniques and optoelectronics devices. Professor Jagadish has received many awards for his work, and in 2005 he was inducted as a Fellow of the Australian Academy of Science."

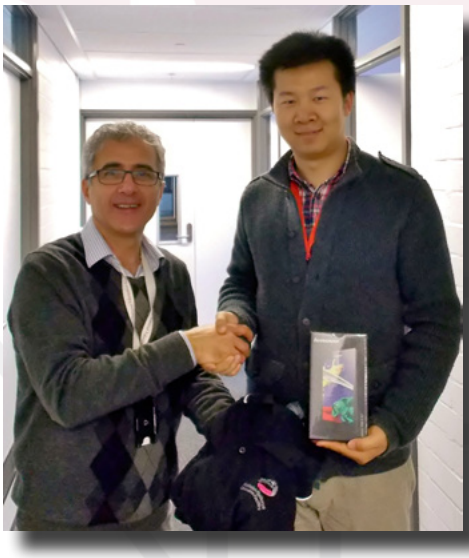
The photo above shows Jagadish receiving the Pioneer Award from IEEE President Professor Howard Michel at Brancaccio Palace in Rome at 2015 IEEE Nanotechnology Conference Banquet on 29th July 2015. Congratulations Jagadish!

2015 User Satisfaction Survey results

Each year we invite users of our facility to participate in a User Satisfaction Survey to gauge our effectiveness in three key areas – service, communication and accessibility. It also provides an opportunity for users to give valuable feedback through additional comments and suggestions to improve the overall experience of accessing this valuable research facility.

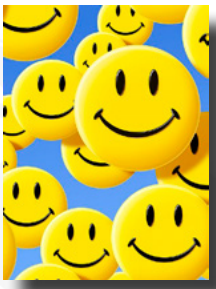
This is the sixth year the survey has been conducted and, while the first year had limited participation, this year was comparable to last year with 63 respondents (close to 40%) compared to 57 for 2014, and more than double the previous three years. As an incentive to participate, we again offered a tablet computer, an ANFF polo shirt and the continuation of offering eight hours machine time to one randomly selected entry. This year Jie (Jason) Cui from the ANU College of Engineering & Computer Science was the lucky recipient (see photo below) and had this to say:

"Thanks for your kind notice. It's a surprise and an honour for me to receive this prize. "My research project is, and will be, largely relied on the ANFF equipment. I sincerely thank the ANFF staff who work hard to maintain the equipment in their best operating conditions."



Our target continues to be achieving an average rating of four or higher (on a five-point scale, 1 = poor, 5 = excellent) in each of the three key areas identified above, and ideally achieve this average rating for each of the 15 questions. This year was the closest we have gone to achieving these goals having finally scored four and above in the three main areas, and having only one question (out of the 15) rating an average of less than four – that being 'Newsletter – design'. This is a very pleasing result and indicates we are continuing to move in the right direction.

To read the complete survey report go to: http://anff-act.anu.edu.au/Documents/user_satisfaction_survey_2015.pdf.



This edition of our newsletter is full of good news! We have our CEO, Rosie Hicks, up for the CSIRO Eureka Prize for Leadership in Science and Mark Lockrey, our SEM-CL Engineer a co-contributor of a photo awarded a 'highly commended' citation in the 'New Scientist Eureka Prize for Science Photography' - not bad!!

Also Jagadish, the ACT Node Director was recently awarded the IEEE Nanotechnology Pioneer Award - a significant accolade - in Rome (see story to the left).

Additionally, we concluded our 6th Annual User Satisfaction Survey producing our best results ever and finally acheived our primary goal of scoring '4 or above' for all three areas the survey covers. This result was acheived with the highest number of respondents and the best participation rate of the whole six years. As always, our users provided very useful feedback on our service delivery and we have already implimented many of these into our operations and communication stategies.

Now we just have to maintain this and crack the '4 or above' for every question! Thanks to everyone who paticipated.

One of the suggestions from the survey was to feature one of the tools on offer at the Node in our newsletter, which coincidently began with our last issue, and prior to the finalisation of the survey, with the article on our new SEM-CL which only came on-line earlier this year.

This issue we have a look at our Barrel Etcher - one of our small process equipment workhorses. For the 2014-15 year this tool was used for over 250 hours by researchers (not including ANFF process development use) meaning it was used, on average, at least one hour for every available day of the year. Check out our article to see if this can be of use to you in your research or contact Fouad Karouta or Kaushal Vora for more details.

(JK)

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