ACT Node & WA Node
NEWS

Providing nano and microfabrication facilities for Australia's researchers

Australian National Fabrication Facility

ACT Node & WA Node

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New Top Down Approach for Fabrication of Nano-wires

During the last half of 2011, the ANFF ACT Node (through EME) hosted a trainee student from Germany, Mareen Gläske. Mareen's work with the node staff focused on the research topic of GaAs nanowires. Normally nanowires are grown in a MOCVD reactor on GaAs templates covered with gold colloidal particles - Mareen investigated another route using micro/nano-fabrication techniques to manufacture the nanowires. If successful, this technique offers the advantage of making nanowires in adequately doped hetero-structures for device applications.

Two methods were used:

- Self-arranged patterning using poly-styrene (PS) spheres followed by etching.
- E-beam lithography to create the patterns and subsequent etching.

The work with the PS spheres was done in collaboration with Dr Qin Li from Curtin University (now with Griffith University) who has extensive experience with PS spheres. The group from Curtin Uni fabricated the PS patterning on bare GaAs wafers and GaAs/AlAs epi-structures. Both types of wafers were first coated with 500nm of SiO_x via PECVD to serve as an etching mask for the compound semi-conductor materials. Subsequently O_2-plasma was used to trim the PS spheres in a controlled manner followed by ICP etching of the SiO_x mask and GaAs as shown in Figure 1. Figure 2 shows the coverage of a GaAs sample with PS spheres of 560nm nominal diameters (left) and the etched SiO_x mask and GaAs.

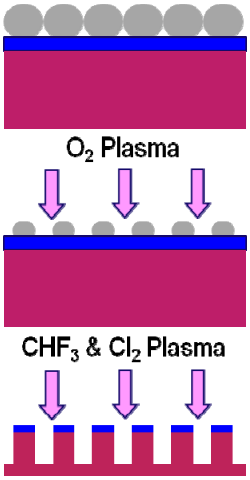


Figure 1: Schematics of the process chart for etching GaAs using PS spheres.

The results confirm that this technique has the potential of achieving nano-wires in GaAs based structures using this cheap patterning technology.

A certain amount of refinement is still required with respect to the trimming of the PS spheres and to optimising the side-wall smoothness.

Another possibility is to use two sizes of PS spheres, as shown in Figure 3 (see over), with a combination of 560nm and sacrificial 277nm PS spheres and using O_2-plasma to trim the largest balls to sizes around 280nm while the small spheres would have completely disappeared. This would enable larger spacing of the PS spheres to facilitate the dry etching of the semiconductor material.

The second technique used in this work was direct patterning using e-beam lithography (EBL) to define circles. Figure 4 (see over) shows the etching results with various sizes of circles/ pillars. The ICP etching involved a gas combination of five gases ($Cl_2/H_2/Ar/BCl_3/CH_4$) required to obtain smooth sidewalls in the GaAs/AlAs stacked

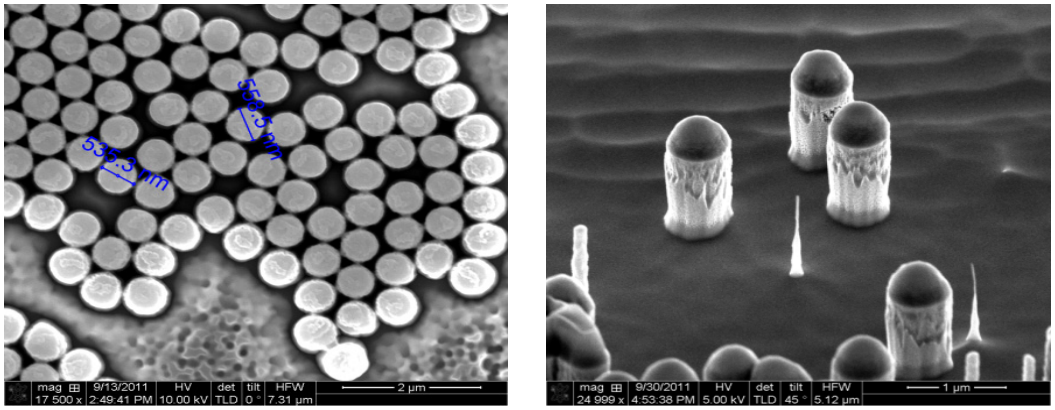


Figure 2: Closely packed PS spheres spread on GaAs (left) and the final etched SiO_x mask and GaAs (right).

ICONN 2012 has now come and gone, but what a successful event it was this year, being held in combination with the **APMC** and **ACMM** events bringing together nanotechnology and microscopy research and technology under one roof. I was lucky enough to be able to attend and assist with the organization and filming of some of the plenerary talks which was a great opportunity.

In this issue we have an article on the research carried out at the ACT Node by **Mareen Gläske**, a student from Germany, focusing on a self assembly technique using polystyrene spheres to create GaAs nano-wires. We also have another interpretation on the use of the tiny spheres illustrated by our 'resident' cartoonist, **Avi Shalav**.

Avi is a post-doc at ANU, sharing his time between the ACT Nodes host, the Department of Electronic Materials Engineering, and the School of Engineering at the ANU College of Engineering & Computer Science. With a bit of luck we may get to use his artistic skills again in the future - thanks Avi!

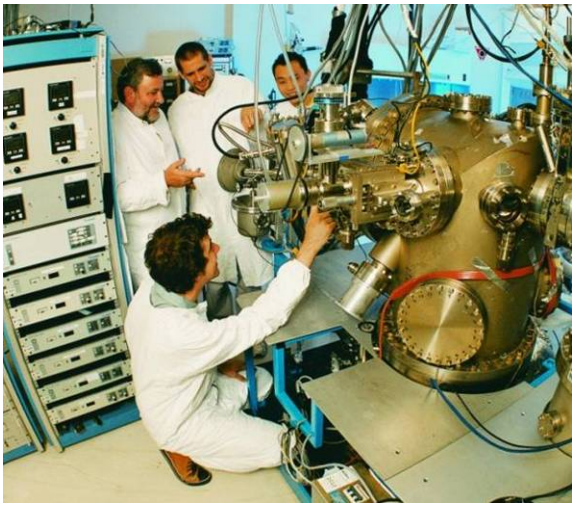
Also, we are happy to congratulate **Laurie Faraone**, WA Node Director, on his appointment as a **Member in the Order of Australia** (AM) on Australia Day 2012. See over for more details.

Next Issue: due June 2012

ACT Node & WA Node info:

- The ACT Node specialises in III-V compound semi-conductors.
- The WA Node specialises in II-VI compound semi-conductors and MEMS.
- We can provide full support with the use of the equipment available.
- Full pricing policy and rates are available on the ANFF website at www.anff.org.au or contact us direct for more information - see contact details overleaf.

WA Node Director on the Australia Day 2012 Honours List



Winthrop Professor Lorenzo Faraone, AM, (far left) and his team from the microelectronics research group with one of their flagship facilities, a molecular beam epitaxy (MBE) system, at the University of Western Australia.

ANFF Western Australia node director and Winthrop Professor Lorenzo Faraone, was appointed a Member in the Order of Australia (AM) on Australia Day 2012.

Professor Faraone's appointment was in recognition of his "service to science as an educator and researcher, particularly in the field of micro-electronics, and to professional associations". He is the Director of ANFF-WA node and head of the Microelectronics Research Group at the University of Western Australia. His team has brought the world's highest level of expertise in the fields of semiconductor opto-electronics, micro-electro-mechanical systems (MEMS) and advanced IR sensors to the ANFF network.

One example of his many notable achievements is the development of an infra-red spectrometer-on-a-chip. This platform technology will enable many applications such as: colour night vision imaging for defence, real-time soil or grain quality analysis in soils for agriculture, or rapid mineral or environmental mapping for mining.

The ANFF would like to congratulate Professor Faraone for his appointment and his many achievements which have led to such a significant accolade.

Story courtesy of Dr Warren McKenzie, ANFFL Business Development Manager

(Continued from page 1)

layers. Though expensive, this technique is showing promise of obtaining well defined and arranged pillars/ nanowires. The technique requires further fine-tuning to enhance the aspect ratio through an optimisation of the masking technique (three level masking with Cr/SiO_x on the semiconductor material).

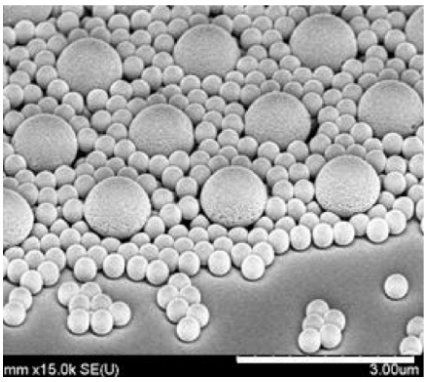
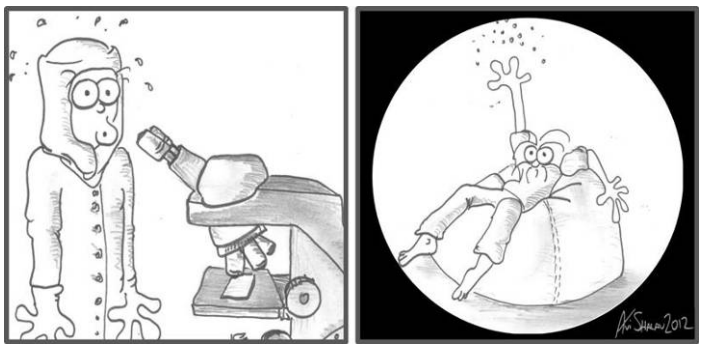


Figure 3: 560nm and 277nm diameter PS spheres combined on a GaAs sample.



Scientist makes breakthrough discovery in use of self assembled nano-sized polystyrene spheres - nano beanbags! © Avi Shalav

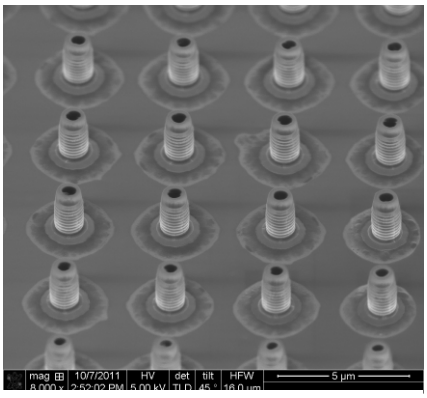


Figure 4: Etching result of pillars using EBL patterning of 1µm circle shapes.

The results of this research were presented by the ACT Node Facility Manager, Dr Fouad Karouta, in an oral presentation at ICONN 2012 held in Perth 5-9 February.

Australia and the 'down under' experience (see photos above).

Mareen Gläske has since returned to Germany, but not before enjoying some of highlights of

Ref: M. Gläske, F. Karouta, E. Eftekhari, Q. Li, J. Tian, K. Vora, X. Li, H.H. Tan and C. Jagadish, "Top-down Approach for Fabricating GaAs-based Nanowires", International Conference on Nanoscience and Nanotechnology, Perth, 5-9 February 2012, paper #974.

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