ANFF

ACT Node News

THE AUSTRALIAN NATIONAL UNIVERSITY

THE UNIVERSITY OF WESTERN AUSTRALIA
Achieving International Excellence

Australian National Fabrication Facility

ACT Node

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New Process Development Work at ANU

Since our last newsletter in March, staff at the ANU facility have been very active developing and refining an entire suite processes for the range of flagship equipment at the facility that is available to researchers from both academic and commercial areas, some of which are highlighted below.

The RAITH 150TT EBL machine has been intensively used for continuing development work on all available resists and particularly using negative resists (ma-N 2405 and 2401) to develop stamps with dots patterns for nano-imprint lithography with the aim of reducing the dot feature size below 100nm. The first nano-imprint tests were carried out using a stamp with µm sized features using a PMDS mould fabricated from the stamp followed by hot embossing in polymer. Figure 1 shows the pattern produced. Effort is now being directed towards reducing the feature size below 100nm combining activities on EBL, ICP etcher and the hot embosser.

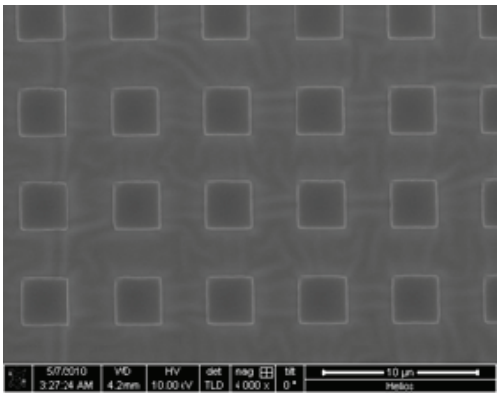


Fig 1: *3-µm square patterns fabricated in polymers by hot embossing*

Further improvement of developed processes has been carried out on etching *GaAs* and *InP* using Cl_2-CH_4-H_2 chemistry with the Inductively Coupled Plasma (ICP) etching system and, more recently, we commenced etching experiments of *GaN*. Further development has been carried out on the selective etching process of *GaAs* towards *AlAs*.

We have also been looking at verticality and smoothness of SiO_x etching for use as stamps in nano-imprinting. As stated above this work has involved the EBL, ICP and NIL systems and the results are shown in Figures 2a & b.

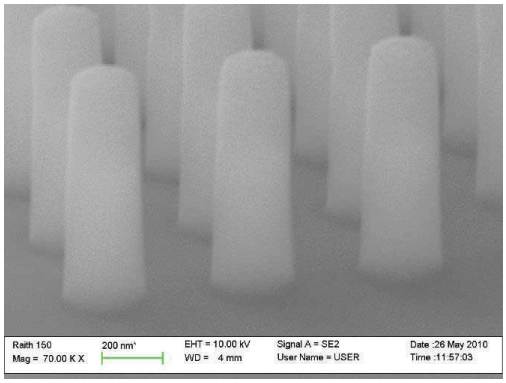
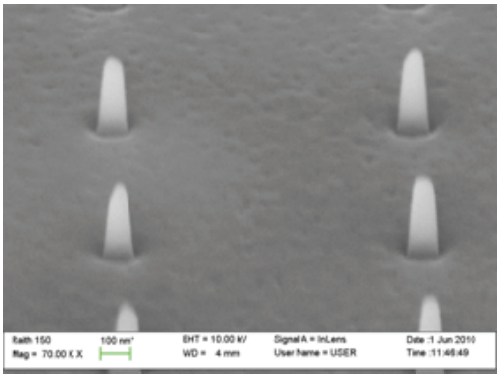


Fig 2a & b: *ICP etching of SiO_x showing 250nm (above) and 100nm (below) pillar shape patterns for nano-imprint applications.*



Since the installation of the Focused Ion Beam system in late February, it has been successfully used for TEM lamellae preparation and other milling works. In the last few months effort has been put towards achieving TEM lamellae preparation in automatic mode down to a thickness of 80nm making the lamellae directly suitable for TEM inspection (see Figure 3 over).

The dual frequency (low and high frequency LF/HF) Plasma Enhanced Chemical Vapour Deposition (PECVD) system offers the ability to control the strain of the SiN_x dielectric layers. This stress study has been conducted extensively on *Si* wafers using the following parameters: stress vs LF/(HF+LF) power; deposition temperature; and as a function of % oxygen in *SiON* layers covering the entire range of refractive index from 1.45 up to 2.0 and we are now looking at developing stress

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Well, while the leaves on the trees are falling *and it's beginning to get a bit chilly again, things are certainly heating up in our labs with a lot of new activity and service requests from all fronts now all the flagship equipment has been installed and word is spreading of our capabilities. Our process engineers continue to refine and develop new techniques and processes for our range of equipment (see our website for full details) - some of which are highlighted in this newsletter.*

If you wish to discuss your project, get advice on how we can assist you and access state-of-the-art equipment at very reasonable rates just call or email Fouad Karouta, the Facility Manager at the ANU Facility or Mariusz Martyniuk at the UWA facility (see contact details overleaf) and they will be more than happy to talk with you.

Other news in this issue:

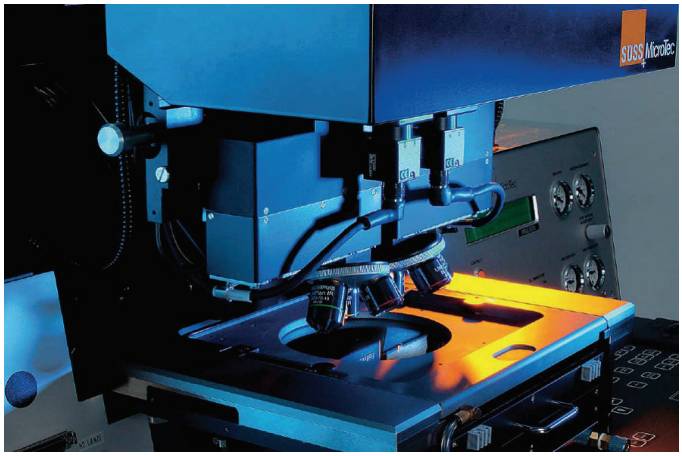
Next Issue:
due September 2010

ACT Node information:

- The ANU facility specialises in III-V compound semi-conductors.
- The UWA facility 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.

Photodetector Array Fabrication Enhancement and Expansion at UWA

The recent success in gaining Linkage Infrastructure, Equipment and Facilities (LIEF) scheme funding will provide a significant thrust to activities within the UWA facility of the ACT Node and enhance Australia's research profile as one of the world's leaders in optoelectronic sensing.



One of the mask aligning systems being considered to replace the existing KarlSuss MJB3 at UWA. Image courtesy of SUSS Microtec.

The funding is aimed at the modernisation, enhancement, and expansion of UWA's capabilities in the fabrication of photodetector arrays. The successful LIEF project, possible by joint collaboration of UWA, ANU, and The University of Adelaide, provides funding for a new mask aligner, spin processing equipment, spectral radiometer system, multi-zone annealing furnace and upgrade of a scanning laser microscope capable of optical beam induced current characterisation.

The tendering process is underway for the acquisition of a top-of-the-line mask aligning system that will replace the outdated KarlSuss MJB3 mask aligning system - the current "workhorse" of the WA Centre for Semiconductor Optoelectronics and Microsystems (WASCOM). Researchers of the Centre are looking forward to the back side alignment capability, enhancing endeavours in the field of micro-electromechanical systems (MEMS) where UWA is the leading Australian institution, and to the nano-inprint lithography capability. This capability will take the Centre's photo-lithography truly into the nanoscale and will be further enhanced by the acquisition of a Headway Research spin processing system spray developer/cleaner/etcher and an EVG105 bake module.

The materials side of the Microelectronics Research Group, Australia's premier research group in infrared detection, will benefit immensely from a new multi-zone annealing furnace enabling accurate annealing of mercury cadmium telluride (*HgCdTe*), which is the highest performance infrared photon detector material known.

Characterisation of fabricated photodetectors will particularly benefit from the remaining acquisitions. Scanning laser microscopy (SLM) is an essential tool for measurement of spatial photo response of detectors. Additionally, the SLM can be used for optical beam induced current (OBIC) imaging and pulsed spatial minority carrier lifetime mapping. This allows characterisation of large numbers of detectors without the need to bond out each individual detector representing a significant reduction in costs and time for array testing. It can also be used to test materials by locating the presence of local electric fields in the material caused by defects or surface inversion regions. The spectral radiometer is an essential characterisation tool to assess performance of photodetectors, giving calibrated responsivity and noise performance as a function of wavelength. The new Optronic Laboratories OL 750D spectroradiometer will be acquired and upgraded to handle multiple devices using a switching matrix allowing automated array testing.

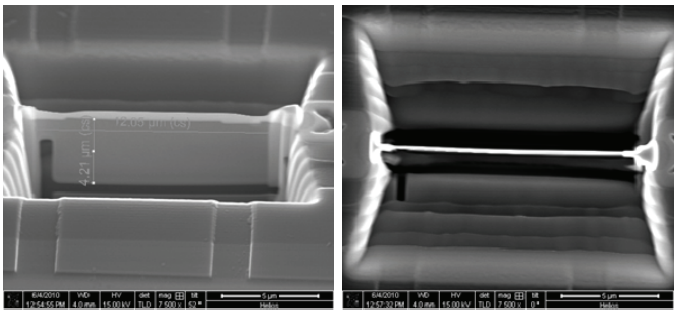


Fig 3: *12µm long TEM lamellae thinned down to 100nm in AUTO TEM mode.*

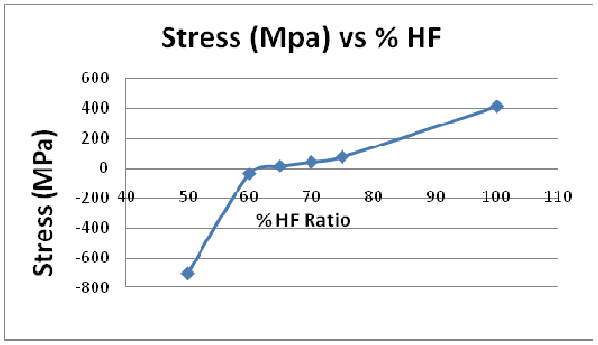


Fig 4: *Stress of SiN_x layers vs HF power %*

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free *SiN_x* layers on *GaAs* and *InP* wafers (see Figure 4).

Besides the flagship equipment described above, the ANU facility also enjoys access to in-kind equipment of the Electronic Materials Engineering group (ion implanter, MOCVD of III-V semiconductors, various processing and metrology) and the Laser Physics Centre, who are active in the Centre for Ultrahigh bandwidth Devices for Optical Systems (CUDOS) - an ARC Centre of Excellence (ICP etching system for *Si*, various metrology tools).

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