Australian National Fabrication Facility
ACT Node & WA Node
NEWSLETTER
ANFF
September 2014 - Issue No. 21

Room Temperature Indium Phosphide Nanowire Lasers

Near-infrared lasers are in great demand for a variety of applications including spectroscopy, optical communication and medical diagnosis and down scaling the footprint of infrared lasers to the nanoscale has significant outcomes for three-dimensional device integration. Indium phosphide (InP), being a direct bandgap semi-conductor with very low surface recombination velocity, is highly relevant as a platform for infrared lasers. To achieve room temperature lasing from single InP nanowire, high quantum efficiency, low surface recombination velocity and good morphology are essential. Hence, the development of high quality InP nanowires with well controlled and variable dimensions has been the subject of intense research efforts.

Qian Gao, a PhD student working at the Department of Electronic Materials Engineering in the Research School of Physics and Engineering at The Australian National University has reported successful growth of high quality InP nanowires of various diameters using selective area metal-organic vapour-phase epitaxy (previously reported in our September 2013 newsletter). Recently, with these high quality InP nanowires, low threshold room-temperature lasing has been achieved.

The InP nanowires were first transferred to an indium tin oxide (ITO) coated glass substrate and then optically pumped at room temperature. Figure 1 (above, right) shows the lasing spectra from a single InP nanowire which also demonstrates clamping of the spontaneous emission above threshold. The clamping of spontaneous emission results from the clamping of the carrier density at threshold, and is an important indicator for the onset of lasing.

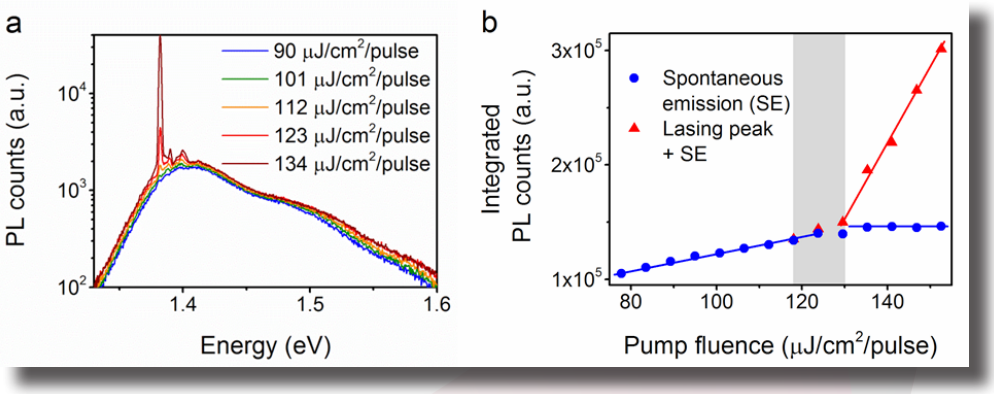

Figure 1. Room temperature lasing characteristics: spectral narrowing and clamping of spontaneous emission.

Excellent material quality and suitable morphology are important for supporting the optical mode and reduce the lasing threshold. To grow these high quality InP nanowires with proper dimensions, patterned substrates were needed before growth, and various tools and facilities of the ANFF ACT Node have been used for preparing these patterned substrates.

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Position Vacant

Microanalysis Research Officer
We are seeking a highly motivated individual for appointment as a Process Engineer at our state-of-the-art ANFF ACT Node.

Location: Canberra, ACT
Closing Date: 21 September 2014
For more details see:
http://jobs.anu.edu.au/PositionDetail.aspx?p=4142

What's in the Boxes??

No, there are no dots on the boxes (see photo, left) but we can assure you it is more exciting than a $4.95 pizza on a Tuesday night!!

Doesn't look all that exciting at the moment but this is a new piece of kit being prepared for installation as part of ANFF ACT Nodes suite of state-of-the-art tools.

We are hoping to have it ready by the beginning of October, however there are a few more accessories to come with the complete build finished by the end of the year.

We're sure there are a lot of our FIB users that are looking forward to this new tool being made available. Any idea's yet?? More details in our next newsletter in December.

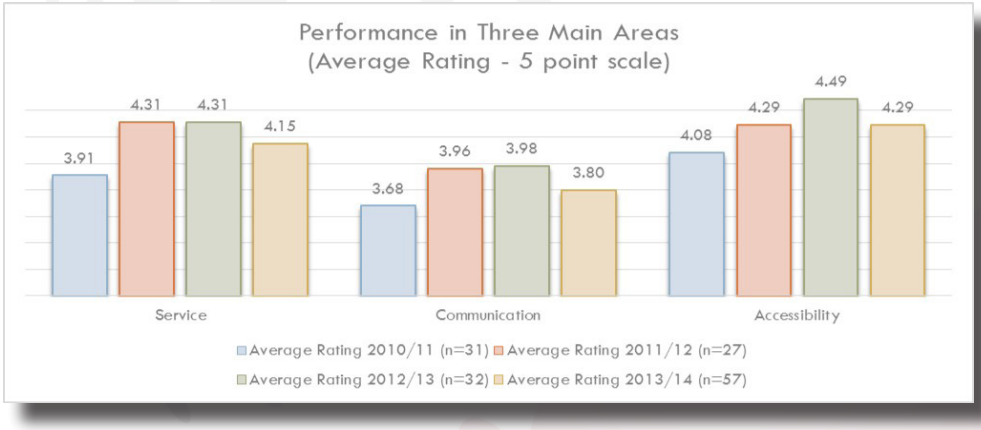
ANFF ACT - User Satisfaction Survey 2013/14

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'. The survey also provides an opportunity for users to give feedback through additional comments and suggestions to improve the overall experience of accessing this valuable research facility.

This year we had a tremendous result with participation with 35% of those invited to take the survey providing responses - up from 22% last year. Our goal is to achieve an average rating of four (4) or higher in each of the three key areas identified above, and ideally, achieve this rating for each of the 15 questions. The chart below shows the broad results for the key areas compared to previous years, and while slightly down on last year the outcome was still a positive one.

Suggestions and comments received from users on our newsletter and website have been taken on board and have resulted in refreshing the design and content of the newsletter and we are currently working on a new website that will have easier navigation, up-to-date content and a fresh look. Many thanks to all those who took the time to participate - we had some very valuable feedback that we will use to continue improving our services. Thanks for the ideas!

You can view the complete survey report on our website - see:
http://anff-act.anu.edu.au/Documents/ACT_documents/user_satisfaction_survey_2014.pdf



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To pattern the InP substrates, 30 nm of SiO_2 was firstly deposited on (111)A InP substrates using the Plasmalab 100 Dual Frequency plasma enhanced chemical vapour deposition (PECVD) tool. The RAITH 150 electron-beam lithography (EBL) system was then used to pattern these substrates, followed by chemical etching through the pattern to form the arrays of holes. Figure 2 (below) schematically shows the processing sequence used for patterning of the InP substrates.

The structural uniformity and high crystal quality of the InP NWs enables low threshold, room temperature lasing from single NWs under optical pumping, opening up new possibilities for both fundamental quantum optics, as well as optoelectronic/photovoltaic device applications.

To utilise these InP nanowires as practical devices, comprehensive fabrication processes have to be further developed and optimised with the assistance from the highly skilled ANFF staff.

Story courtesy of Qian Gao,
Department of Electronic Materials Engineering,
RSPE, ANU.

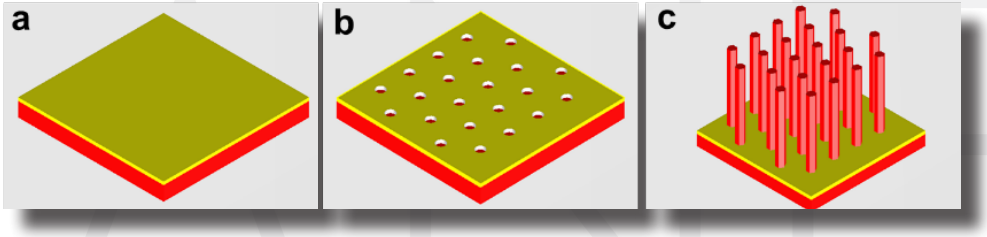
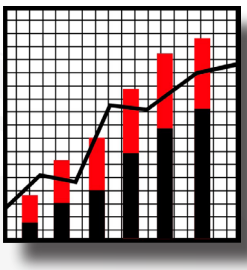


Figure 2. Schematic of the processing sequence used for selective-area epitaxy growth of InP nanowires. (a) InP substrate with SiO_2, (b) The hexagonal array pattern opened up on SiO_2 mask. (c) The nanowire array grown on SiO_2 patterned substrate.



This is always an interesting time of year to send out our quarterly newsletter. We are usually in the middle of collating and preparing a lot of data for our annual progress reports which gives us the opportunity to reflect on the achievements of the previous year and plan for the year ahead.

Just some of the statistics for the ACT Node alone include more than 160 individual users accessing our facilities in 2013/14 and more than 180 people receiving some form of training, either individually or in groups, or undertaking an induction course for the facility.

And, for the first time, we topped 10,000 recorded facility hours for the year, including process development and equipment maintenance. From these hours there were close to 60 collaborations (some with multiple projects) with both national and international institutions and industries, not including those within ANU itself, that resulted in more than 50 journal papers in 2013.

And we are just one of eight nodes across Australia - giving you an idea of the impact and value of this national facility. You can always find more details on other nodes of the ANFF by visiting the main website at: www.anff.org.au.

Also to be found on the ANFF website are the details of this year's Annual Research Showcase being held in Canberra on the 18-19 November 2014 at the Shine Dome. This year's theme is 'Innovation – the creation of new products and services' and is an opportunity for ANFF users to present innovative work carried out in ANFF facilities across the Nodes. This showcase will demonstrate that ANFF really is 'A Platform for Innovation'. (JK).

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