Australian National Fabrication Facility
ACT Node & WA Node
NEWSLETTER
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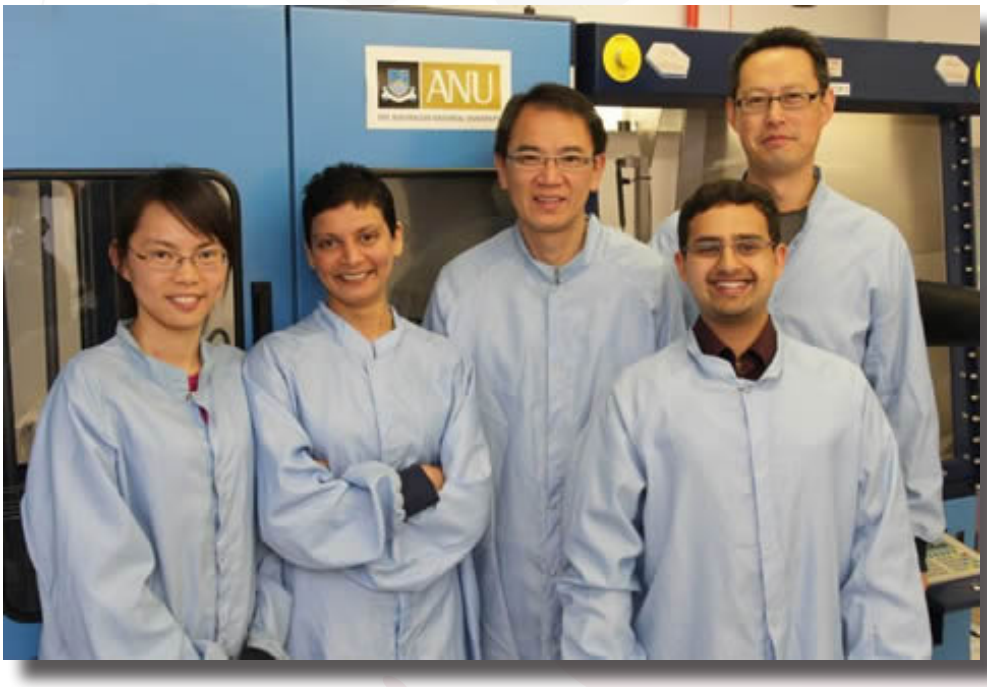
Computing at the Speed of Light!

Faster, smaller electronics are one step closer with researchers from The Australian National University successfully making the first room temperature lasers from gallium arsenide (GaAs) nanowires.



These wires and lasers will lead to faster, lighter computers as light travels faster than electrons allowing data to be processed much faster. Dhruv Saxena, a PhD student at the Department of Electronic Materials Engineering (EME), has just co-authored a paper with Dr Sudha Mokkapati, an ANU-based ARC Super Science Fellow (also at EME), that has been published in NATURE PHOTONICS explaining how to make smaller lasers using GaAs nanowires – solid wires a few billionths of a metre in diameter.

"The lasers in use at the moment often require a lot of processing steps to produce a nice cavity and mirrors in order to emit laser light," explains Saxena, who went on to say that these older lasers also are much bulkier. These new GaAs wires are 'grown' in the lab, using a process called Metal Organic Chemical Vapour Deposition (MOCVD) – one of the tools available at the ACT Node of the ANFF – where a substrate is covered with gold particles that act as catalysts, or 'seeds'. Gases containing gallium and arsenic are added and the temperature of the substrate is raised up to 750°C. At these temperatures the elements react and nanowires begin to grow.

"It is crystal growth. The substrate provides the direction of the growth, so they grow straight up, standing vertically on the substrate instead of growing in random directions," says Saxena. This vertical orientation would allow for the fabrication of more compact and densely-packed computer processing chips. Saxena says building computer chips from these wires would still require years of development, but showing that these nanowire lasers can operate at room temperature is an important development that will lead to cheaper, faster and lighter computers.

Professor Chennupati Jagadish, who leads the research, says these lasers are some of the smallest in the world.

"The smaller the lasers the faster we can switch them on and off, so we can send information much faster. "Particularly when you are dealing with computer chips and when you are making electronic devices smaller, the resistance of the metals which are being used to communicate between transistors becomes very large. "This is becoming a real bottle-neck for the speed at which we are able to transfer information between the computer chips and within the computer chips. "That's where people are looking for optical sources because light can travel much faster."

Prof. Jagadish says while other nanowires have been developed, they have only been able to

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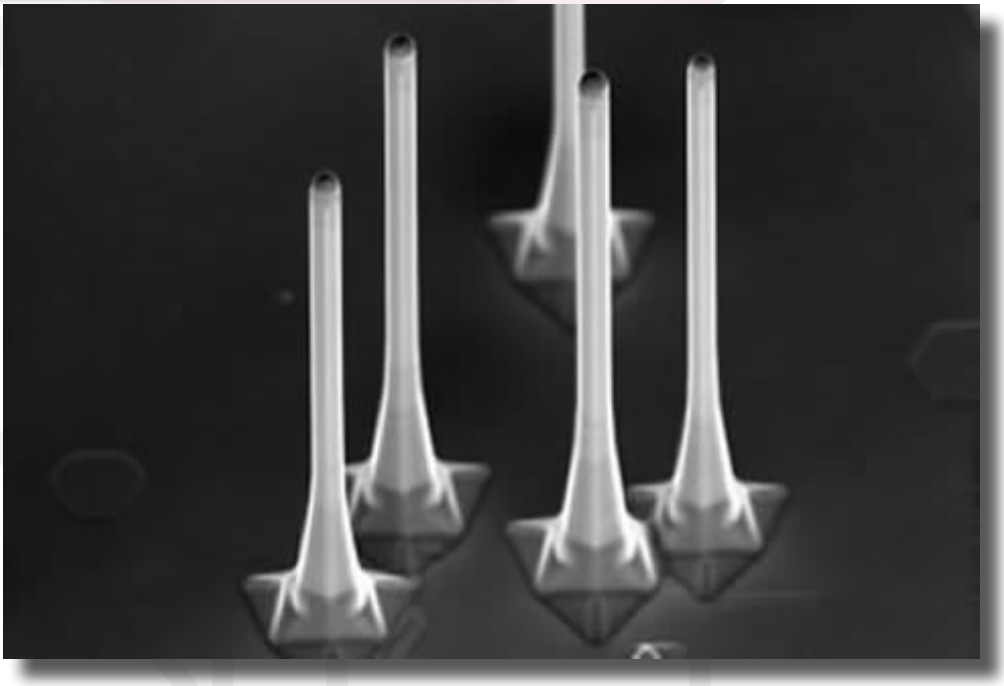

Top - the ANU research group: L-R Nian Jiang, Dr Sudha Mokkapati, Professor Hark Hoe Tan, Dhruv Saxena and Dr Qiang Gao. Above - an SEM image of the GaAs nanowires growing on the substrate clearly showing the gold catalyst 'seed' at the top of each nanowire. Size is ~6 µm high with a diameter of 320 nm. Images supplied by The Australian National University.

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operate at lower temperatures. "Low temperatures mean we are unable to use it in day-to-day applications so that's why making these lasers to work at room temperature is a significant milestone," he said.

This breakthrough work has received a lot of attention and more articles can be found here:

Nanowires to rev up computers of tomorrow *- ABC Science -*
http://www.abc.net.au/science/articles/2013/11/18/3891736.htm

Tiny laser breakthrough by ANU researchers shines light on faster computers *- ABC News -*
http://www.abc.net.au/news/2013-11-18/tiny-laser-breakthrough-may-lead-to-faster-computers/5098266

And for those you wish to look at the actual ***NATURE*** journal publication, you can find it here -
http://www.nature.com/nphoton/journal/vaop/ncurrent/abs/nphoton.2013.303.html
(link dependant on appropriate access).

Persistence Pays Off for WA Node

The long lasting efforts of the WA Node of the ANFF to secure financial support from the Western Australian State Government has paid off. The Office of Science within the Department of the Premier and Cabinet of the WA Government announced that, as part of the Innovation Co-investment Program, it will support the ANFF initiative in WA with $150,000 over the 18 month Federal Government Collaborative Research Infrastructure Scheme (CRIS) period from 1 July 2013 to 30 June 2015.

"This is an excellent outcome of a long standing effort. We are very happy with the outcome and thankful for this support which means that, for the first time since the establishment of the ANFF, the WA Node will be supported by State Government funding." said the ANFF WA Node Director, Professor Lorenzo Faraone.

The financial support from the WA Government will be directed towards the purchase of new state-of-the-art equipment, staff salaries and operating costs of the Node. This will significantly assist in maintaining the internationally recognised research excellence that is well established in Western Australia.

Government of **Western Australia**
Department of **the Premier and Cabinet**
Office of Science

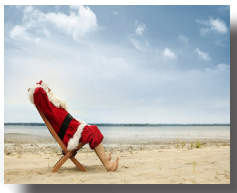
Welcome to our new MOCVD Process Engineer!

Mykhaylo Lysevych (left) receiving an award from ANFF CEO, Rosie Hicks at the recent ANFF ACT Node Workshop

The ANFF ACT Node has just appointed Mykhaylo Lysevych as the Process Engineer to look after the newly installed (and old) MOCVD reactors.

Mykhaylo completed his Bachelor of Engineering in Electronic Engineering (Laser and Optoelectronic Systems) in 2003 at Lviv Polytechnic National University in the Ukraine. In 2005 he joined the Department of Electronic Materials Engineering (EME) at The Australian National University as an MPhil student working on "Design, Growth, Fabrication and Characterisation of AlInGaAs/InP Lasers". A significant part of the project dealt with the development of the MOCVD growth of optical quality of materials containing aluminium on indium phosphide (InP). After successfully completing the MPhil in 2007, Mykhaylo continued to work on lasers as a PhD student at EME. He studied the concept of broad-waveguide lasers for high power single spatial mode InP-based lasers, during which time he developed methods for increasing laser output power. Very critical for producing high power lasers is the low loss optical waveguide and the development of an MOCVD growth regime resulting in precisely controlled doping profile was essential.

His research interests include epitaxial growth, lasers, LEDs, optical waveguides, device design and numerical modelling, device fabrication and characterisation.



As another year draws to a close it gives us time to reflect on all the achievements of the year - although it is unlikely I'll be doing in the style of the gentleman above!

New tools and equipment have been installed (the new MOCVDs at the ACT Node should be switched on as you read this), users trained, even a new layout and design for the newsletter (based on feedback from our recent user survey) and world-class research being carried out. The last bit may not be us directly but rather you, - our readers and researchers at the many institutions - both national and international, that these facilities support.

A measure of this can be seen in the vast array of research publications we are now listing on our web site (see News & Links - Publications), including the recent **NATURE Photonics** paper (see main article) that have accessed and acknowledged the ANFF in their research – and we are adding to this regularly. We genuinely thank you for these contributions as, not only does it make our work here worthwhile, but raises the profile of the ANFF overall attracting more and more researchers like yourself. If you would like your work added to our list just send us the details.

So, as this will be our last newsletter for the year, all the staff at the ACT and WA Nodes of the ANFF would like to take this opportunity to wish you all, both researchers and readers, a very Merry Christmas and a safe and enjoyable New Year.

We look forward to continuing our services to you in 2014 and beyond! (JK)

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