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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Indium Phosphide Nanowire Photoconductors

A tremendous amount of research is being carried out in the field of nanowires and the excitement in this field is due to the unique properties of these nanowires. Nanowires have an extremely large surface area which leads to ultra high surface reaction efficiency. Changing the surface conditions by surface reactions with chemicals, gases and biological substances, including DNA/viruses, can lead to large changes in nanowire properties with ultra-sensitive sensors based on nanowires being reported.

Nanowire devices such as lasers, resonant tunnelling diodes, single electron transistors, photodetectors, and solar cells have also been demonstrated. Indeed, nanowires have a broad range of applications, which encompasses many science and engineering areas such as electronics, photonics, biological and medical technologies. The success of nanowires as building blocks for nano-devices relies not only on the synthesis of these materials but also the ability to fabricate them on the nano-scale into devices.

In this article, photoconductors based on Indium Phosphide (InP) nanowires were fabricated using various facilities of the ANFF ACT Node. The 50nm diameter InP nanowires were grown using the Au-catalysed technique by MOCVD with lengths varying from 4-15µm.

After growth, the nanowires were removed from the substrate by sonication for 10 to 20 seconds in isopropanol. 200nm of SiOx was deposited on a Si substrate at 600°C by PECVD using the ACT Node's Oxford Instruments PlasmaLab 100 machine. Optical lithography was carried out to define regions of contact pads on the substrate. Ti/Au (5nm/200nm) was then deposited on the patterned substrate using the Temescal BJD-2000 Electron Beam Evaporator followed by acetone lift-off process.

The isopropanol suspension containing the InP nanowires was then applied on the patterned wafer. Many nanowires were found dispersed on the patterned substrate upon evaporation of the isopropanol solution. By choosing nanowires that lie across two Au contact pads, further contacts were made using the FEI Helios 600 NanoLab Focused Ion Beam system. Gallium ion-induced Pt deposition was used to bond the nanowires onto the Au pads. A schematic of the device structure is shown in Figure 1, whilst Figure 2 (see over) shows the SEM image of a typical nanowire device.

Electrical measurements show a linear current-voltage relationship, indicating the formation of Ohmic contacts (see Figure 3a) for all lengths of nanowires studied here. The results of optical excitation using a 522nm laser are shown in Figure 3b.

By increasing the intensity of the excitation beam, an increase in the photocurrent is observed, while still preserving the Ohmic contacts.

The successful demonstration of these devices shows that the fabrication techniques used are feasible and reliable. It also allows us to venture into more exciting structures such as axial and radial (core-shell) heterostructures.

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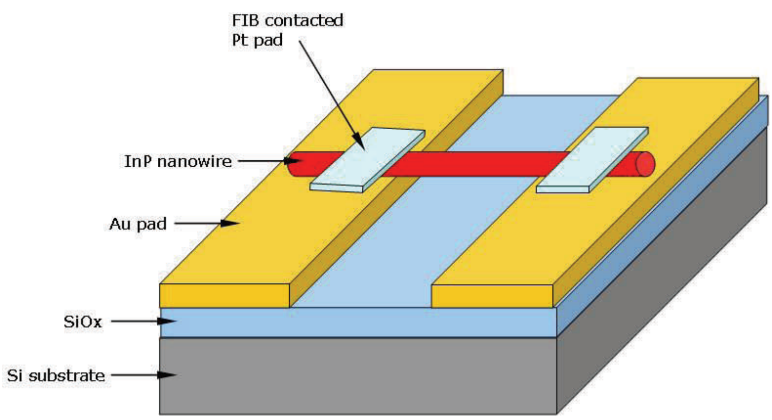

Figure 1: Schematic of InP nanowire (red bar) contacted by FIB Pt on the top of Au pads

ICONN 2012 *is being held in Perth in February next year along with* ***ACMM22*** *and* ***APMC10*** *as a single integrated event. This combined event will be the largest microscopy and nanotechnology-related event in Australia's history. Over 2,000 delegates from more than 30 nations are expected to provide a unique and exciting forum. Our colleagues at the WA Node will be hosting a full day nano-fabrication course at UWA -* ***for more details see the story overleaf.*** *Abstract submissions are now open - check out the website at: http://www.iconn-2012.org/ .*

Our main story this issue focuses on some exciting work being carried out at ANU with nanowires. This is a great example of how easy access to a range of state-of-the-art fabrication tools, along with local expertise, in one location is assisting with quality research. Prakash Prasai has accessed a number of our flagship machines (E-beam Evaporator, FIB and PECVD to name three) along with EME's MOCVD, which is just one of the ANU's in-kind facilities available through our Node.

Why not contact us and ask how we can assist with your research or project.

Next Issue:
due December 2011

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.

Physics Nobel Prize winner Z. Alferov at ICONN2012

Perth, Western Australia to host ICONN2012

Call for abstracts is now open for the next International Conference on Nanoscience and Nanotechnology (ICONN 2012) to be held in Perth, WA in February 2012. On this occasion, the conference is being co-organised and co-located with the Asia-Pacific Microscopy Conference (APMC-10) and the Australian Conference on Microscopy and Microanalysis (ACMM-22).

The event will include four days of a variety of short courses and hands-on workshops on nanofabrication and characterization techniques with Australian National Fabrication Facility as the patron of a full day workshop on nanofabrication technologies.

This combined event will be the largest nanotechnology and microscopy related event in Australia's history. Over 2,000 delegates, from more than 30 nations are expected to provide a unique science and technology forum. The traditional scientific programs of each Conference will be run parallel with some joined sessions, and delegates may attend any they choose. Concurrent major equipment exhibitions (100 booths!) and social events will be fully shared, to enable our communities to network extensively.

Confirmed plenary speakers include the winner of the 2000 Nobel Prize in Physics, Zhores Alferov; the winner of the 2011 Wolf Prize in Physics, Knut Urban; and a 2010 top 100 most-cited researcher in nanotechnology, Frank Caruso.

Substantial registration and travel support is made available for eligible PhD students and early carrier researchers by the organising committee. You can find more details at the ICONN2012 website - http://www.iconn-2012.org/.

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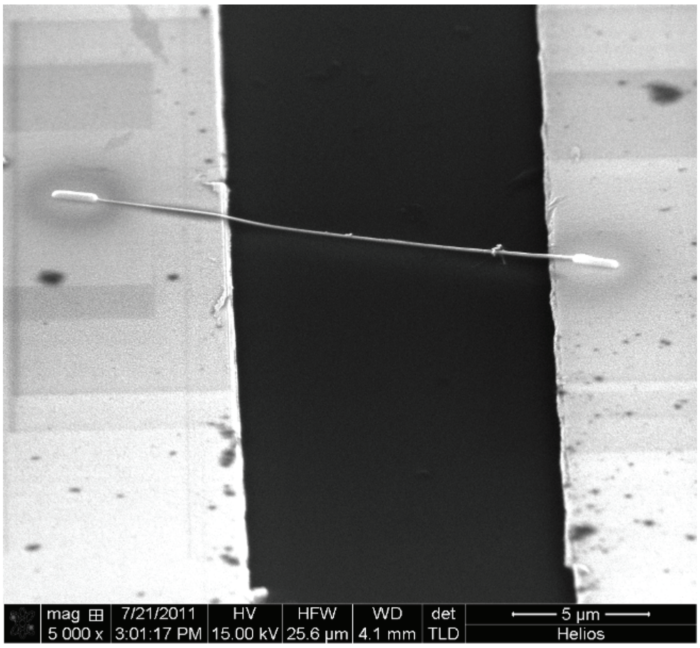
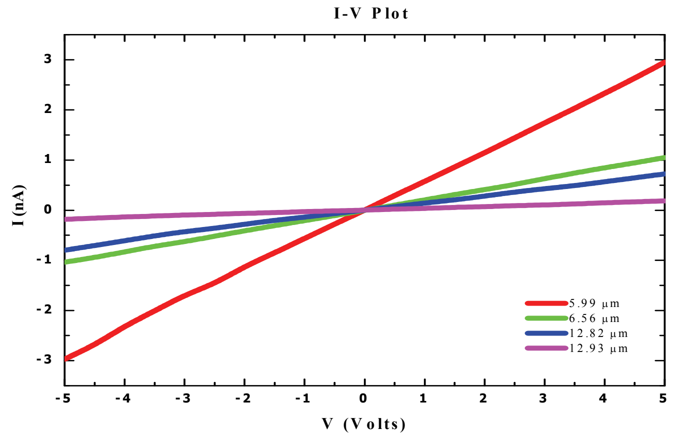


Figure 2: Field Emission Scanning Electron Microscopy (FE-SEM) image of InP nanowire contacted by FIB Pt on Au electrodes.



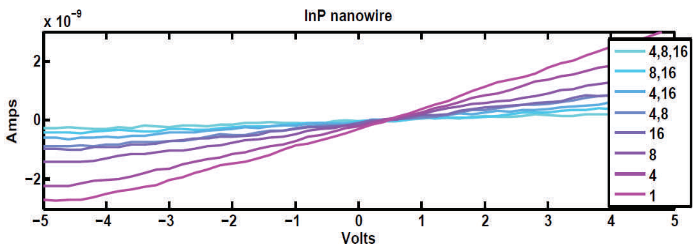


Figure 3a (top): Current-voltage characteristics of FIB Pt contacted InP nanowires having different lengths. Fig 3b (above) shows current-voltage relationship with different laser powers, 1 being the maximum laser power (measured as 717µJcm^{-2}) and (4,8,16) the minimum laser power. 4,8,16 denote for neutral density filters.

However, it is worth noting ion beam deposition conditions such as deposition time, dimensions and current must be carefully optimised to avoid/minimise gallium ion generated artefacts such as Pt spill over, sputtering around the contact areas, device short circuiting from Pt spreading and ion beam induced damage. More systematic experiments and analysis need to be carried out to investigate the relationship between the NW structural properties (length, diameter, crystallography, etc) and the electrical properties of the NWs.

Story courtesy of Prakash Prasai, Dept of Electronic Materials Engineering, ANU.

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