**B2: Diffraction Gratings for Light-Trapping in Quantum Well Solar Cells**
*Sam Turner – ANU-RSPE-EME*
Diffraction gratings can act as light-trapping structures at the rear of InGaAs/GaAs quantum well solar cells for the purpose of enhancing the efficiency of the weakly absorbing quantum well region beyond the band-edge of GaAs. Through finite-difference time-domain simulations optimum grating parameters have been identified for both metallic (plasmonics) and dielectric diffraction gratings. Electron beam lithography and both sputtering and electron beam deposition are employed to fabricate metallic and dielectric diffraction gratings on the rear of processed quantum well solar cells.

**B3: Ge nano-particle embedded in Si N**
*Sahar Mirzaei, ANU-RSPE-EME*
Ge NPs were formed in a 2-µm-thick a- SiN matrix by ion implantation, at liquid nitrogen and high temperature, for different fluencies at different energies. The implantation was followed by thermal annealing at 1100°C for 10 h/1h, under $N_2$ ambient. Extended x-ray-absorption fine-structure has been used to measure the composition dependence of the Ge-Ge and Ge-Si bond length in both crystalline and amorphous Ge Si nanoparticles. Raman spectroscopy also confirms the fingerprint of Ge Si.

**B4: InP nanowries grown by selective-area metal-organic vapour-phase epitaxy**
*Qian GAO - ANU-RSPE-EME*
Selective-area epitaxy is a technique that can be used to grow nanowires without the use of a metal catalyst. This involves nanopatterning a substrate using Electron beam lithography and depositing the nanowries using an MOCVD system. In this talk, I will present our work on growing high quality InP nanowires by this technique. Results from TEM samples prepared by focus ion beam will also be presented.

**B5: Highly angle tolerant spectral filter**
*Duk-Yong Choi – ANU-RSPE-LPC (in collaboration with Kwangwoon University, South Korea)*
High angular tolerant spectral filters were realised incorporating etalon resonators; one consists of a $TiO_2$ cavity sandwiched between a pair of Ag/Ge mirrors, the other three stages concatenated with a-Si and $SiO_2$.

# First ANFF ACT Node Workshop

## ANU – Huxley Theatre

## Tuesday 25 June 2013

## Digest of Abstracts

**1:30-2:50pm: Welcome and Session A**

### A1: Fabrication of multi-section, monolithically integrated semiconductor lasers

*Pawel Sajewicz, ANU-RSPE-EME*

Fabrication of the monolithically integrated devices is often a complex process that requires many steps. Each of them is crucial for successful operation of the devices. In order to carefully monitor and optimise the fabrication process, we use ANFF equipment at various stages of the fabrication. In this presentation we are going to talk about the development of key fabrication processes using ANFF equipment for fabrication of multi-section integrated InGaAs/AlGaAs quantum well lasers.

### A2: Metal-assisted etching for SLIVER solar cells

*Kate Booker, ANU-CECS*

A major barrier in the development of SLIVER solar cells is the need to use expensive, custom-made <110> wafers. Metal assisted etching represents a novel method for manufacturing SLIVER grooves which is independent of crystal orientation through metal-catalysed etch reactions. This technique significantly reduces material costs and increases the flexibility of processing parameters.

### A3: Ga-catalysed GaAs Nanowires on Si by MOVPE

*Steffen Breuer, ANU-RSPE-EME*

When nanowires are grown on Si substrates, a different catalyst material than Au is required to avoid deep trap levels caused by Au incorporation into the Si substrate. One solution is self-catalysed VLS growth, thus using Ga droplets as catalysts. So far, growth efforts focussed on molecular beam epitaxy (MBE). Here we present successful MOVPE growth on Si of Ga-catalysed GaAs nanowires. We discuss growth, morphology and structure, which are similar in many aspects to the high standard already achieved by MBE.

### A4: Silicon and Germanium Sample Preparation for Hall Effect measurement via Deposition, Photolithography and Wet etching

*Andy Feng, ANU-RSPE-EME*

Protocols for preparing silicon and germanium samples in clover leaf pattern for Hall Effect measurement have been developed briefly as following: For silicon, 1. Use PECVD to deposit 100nm Si3N4 on the sample; 2. Make the wanted pattern in photoresist on the Si3N4 by means of photolithography; 3. Etch Si3N4 with photoresist as the mask; 4. Pattern the Si with KOH by using the Si3N4 as a hard mask; 5. Remove remaining $Si_3N_4$; 6. Do photolithography again and use Photoresist as a mask for metal deposition and do lift off. Germanium samples are the same but $Si_3N_4$ is not needed since photoresist can be the mask for germanium etching.

### A5: Merged Beam InP-based Laser

*Mykhaylo Lysevysh – ANU – RSPE - EMEC*

Merged beam laser (MBL) uses its unique cavity design to increase the laser's output power while maintaining single mode operation. By dividing the laser beam into two, the intensity dependent gain-saturation can be reduced. However this cavity design contains branching regions which if fabricated incorrectly will result in excessive losses and inoperable device. For the fabrication of the devices we relied on equipment and expertise of ANFF – ACT Node.

### A6: The ANFF SA Node

*Simon Doe, UniSA-ANFF SA Node*

The ANFF-SA node is headquartered at UniSA and is partnered with Flinders University. The node is focused on facilitating Research Excellence in Microfabrication, Microfluidics and Surface Science. The talk will present some of the tools and capabilities via case studies.

**2:50-3:10pm: Afternoon tea**

**3:10-4:30pm: Session B and Closing**

### B1: PECVD/ALD layers - uses in photovoltaics

*Andrew Thomson – ANU – CECS*

I will describe ongoing research being conducted by the Research School of Engineering involving use of ANFF tools. Specifically we will detail passivation and optics studies of SiNx on silicon. Additionally we will discuss: plasmonic structures used for light trapping in solar cells; tunneling contact formation to increase solar cell passivation; and current cell fabrication processes being undertaken at the Research School of Engineering.