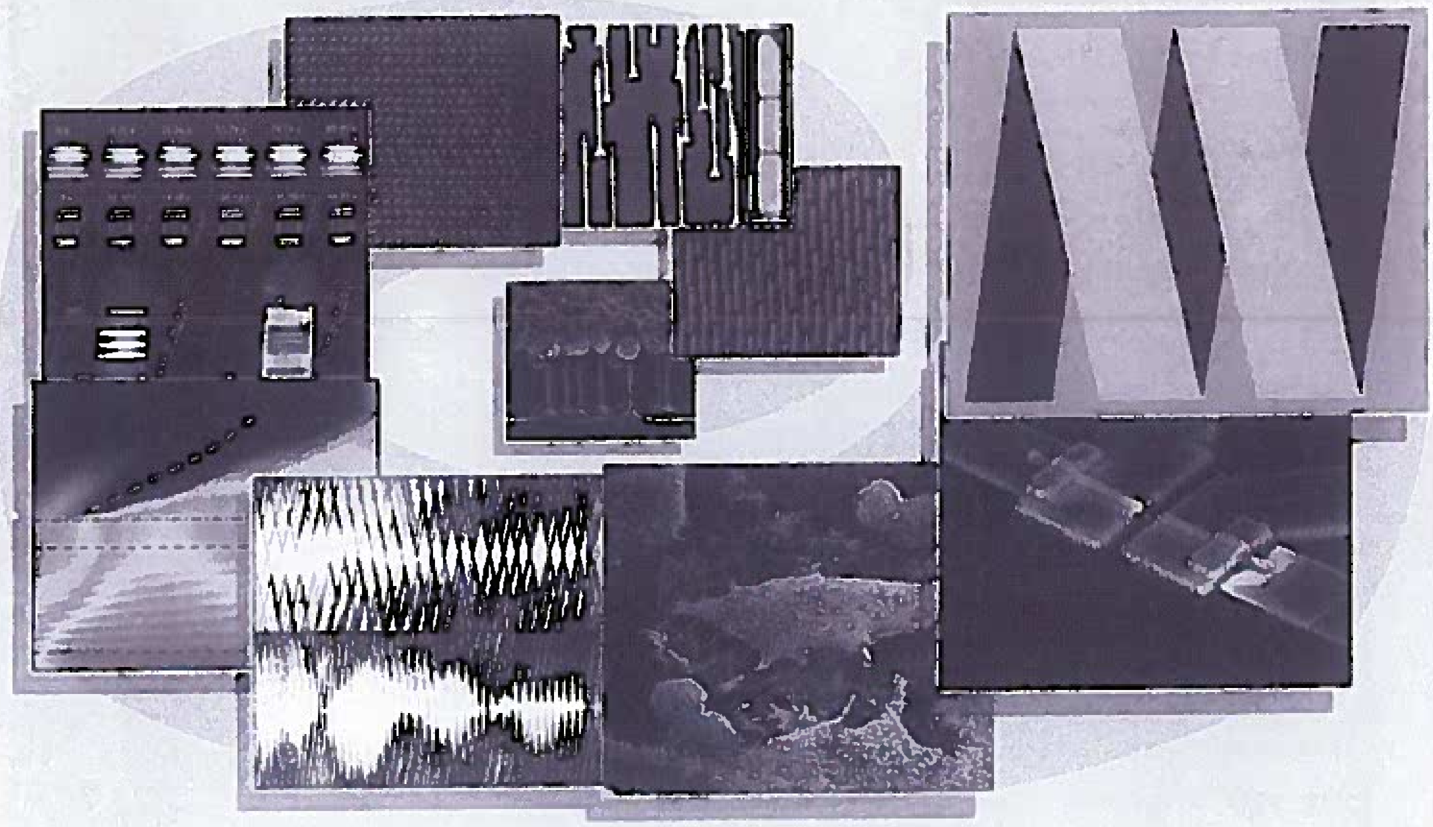
10th Nanowire Growth Workshop + 9th NANOWIRES

NANOWIRE WEEK 2017

May 29th - June 2nd, Lund, Sweden



Program

Tuesday, May 30, 2017

9:00 – 10:30	Oral Session Tu1 Chair: Rainer Timm	
9:00 – 9:30	**Masamitu Takahasi** National Institutes for Quantum and Radiological Science & Technology, Japan *Atomic ordering and nucleation at the AuGa droplet-GaAs crystal interface studied by in situ X-ray diffraction*	Invited I4
9:30 – 9:50	**Ludwig Feigl** Inst. for Photon Science & Synchrotron Radiation, Karlsruhe Inst.Tech., Germany *Time-resolved in-situ X-ray investigations during growth of $In_xGa_{1-x}As$ core-shell nanowire structures*	Contributed Tu1.1
9:50 – 10:10	**Megan O. Hill** Department of Materials Science & Engineering, Northwestern University, U.S.A. *Analysis of stacking disorder in InGaAs nanowires using 2D Bragg Projection Ptychography*	Contributed Tu1.2
10:10 – 10:30	**Dong Pan** Institute of Semiconductors, Chinese Academy of Sciences, China *Near full-composition-range high-quality $GaAs_{1-x}Sb_x$ nanowires grown by molecular-beam epitaxy*	Contributed Tu1.3

10:30 – 11:10 Coffee Break

11:10 – 13:00	Oral Session Tu2 Chair: Anna Fontcuberta I Morral	
11:10 – 11:40	**Philippe Caroff** School of Physics and Astronomy, Cardiff University, U.K. *Shape engineering in III-V nanostructures beyond the nanowire geometry*	Invited I5
11:40 – 12:00	**Katsuhiro Tomioka** Research Center for Integrated Quantum Electronics, Hokkaido University, Japan *Selective-area growth of InGaAs nanowires with various In compositions on Ge(111) substrates*	Contributed Tu2.1
12:00 – 12:20	**Jung-Hyun (Jordan) Kang** Braun Center for Submicron Research, Weizmann Institute of Science, Israel *Wurtzite/zinc-blende interconnected InAs nanowires with embedded two-dimensional wurtzite plates*	Contributed Tu2.2
12:20 – 12:40	**Thomas Kanne** Niels Bohr Institute, University of Copenhagen, Denmark *Epitaxial InAsSb/Al hybrid nanowire materials for topological superconductivity*	Contributed Tu2.3
12:40 – 13:00	**Ryan B. Lewis** Paul-Drude-Institut für Festkörperelektronik,Germany *Bismuth surfactant-induced self-assembly of InAs nanostructures on the {110} sidewalls of GaAs nanowires*	Contributed Tu2.4

13:00 – 14:00 Lunch

14:00 – 16:00 **Poster Session 2** (with coffee served at 15:30)

16:00 – 17:00	Oral Session Tu3 Chair: Karen Kavanagh	
16:00 – 16:20	**Akhil Ajay** University Grenoble-Alpes, CEA-INAC-PHELIQS & CNRS-Institut Néel, France *Germanium vs. silicon doping of GaN/AlN nanowire heterostructures for intersubband optoelectronics at 1.55 μm*	Contributed Tu3.1
16:20 – 16:40	**Suzanne Lancaster** Institute for Solid State Electronics, TU Wien, Austria *Incorporation of Boron in GaAs nanowires grown by self-catalysed molecular beam epitaxy*	Contributed Tu3.2
16:40 – 17:00	**Kenichi Kawaguchi** Fujitsu Limited, Wireless System Div., Atsugi, Japan *Heavily sulfur-doped InAs nanowires formed by position-controlled VLS growth method*	Contributed Tu3.3

Incorporation of Boron in GaAs nanowires grown by self-catalysed molecular beam epitaxy

Suzanne Lancaster[1], Heiko Groiss[2], Donald MacFarland[1], Tobias Zederbauer[1], Aaron Maxwell Andrews[1], Werner Schrenk[1], Gottfried Strasser[1], Hermann Detz[1,3]

[1] *Centre for Micro- and Nanostructures, Institute for Solid State Electronics, TU Wien, 1040 Vienna, Austria*
[2] *Institute of Semiconductor and Solid State Physics, Johannes Kepler University, 4040 Linz, Austria*
[3]*Austrian Academy of Sciences, 1010 Vienna, Austria*

Email: Suzanne.lancaster@tuwien.ac.at
Keywords: Growth, alloys and doping, electrical properties

Boron arsenide (BAs) and related compounds (BGaAs, BInGaAs) are one of the least-studied III-V material systems. We have investigated the underlying mechanism of boron incorporation in GaAs nanowires (NWs) grown by self-catalysed molecular beam epitaxy (MBE) via structural, optical and electrical methods.

Transmission electron microscopy (TEM) images of the nanowires show that the NWs grew with 'voids' on the surface (fig. 1a). Energy-dispersive X-ray spectroscopy (EDX) analysis indicated that these voids are boron-rich, but without the native oxide which is present on the surrounding GaAs (figs. 1b & c). This suggests B clusters formed on the surface of the nanowires.

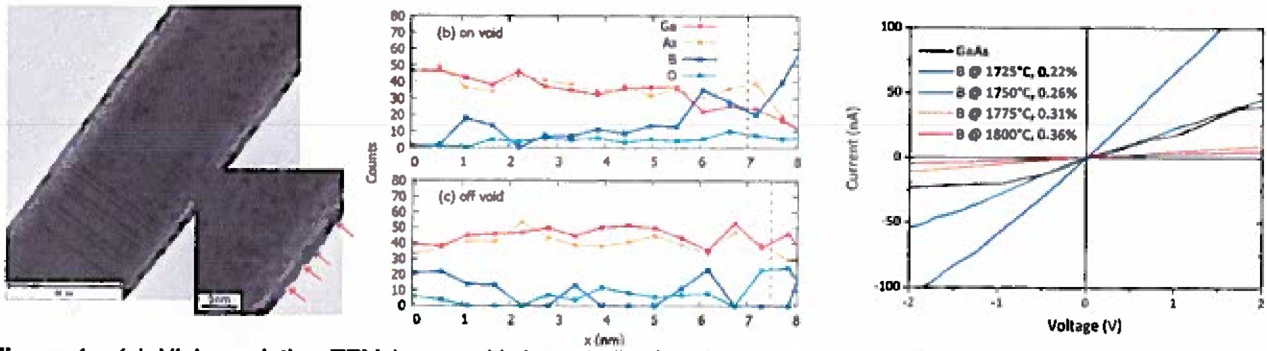


Figure 1. *(a) High-resolution TEM image with inset indicating the presence of 'voids' (black spots) on the (B)GaAs nanowire surface. EDX scans of a nanowire edge (b) across one of the visible black spots and (c) across the normal nanowire surface. Black dashed lines indicate the edge of the nanowire. (d) 2pt current-voltage measurements for (B)GaAs nanowires grown with varying B cell temperature, indicating % boron incorporation extracted from X-ray diffraction measurements on epilayers.*

Epitaxial BGaAs layers were confirmed to be p-type[1]. To this end, the nanowires were contacted with Au/Zn/Au (5/10/100nm) via e-beam lithography and thermal evaporation, for 2- and 4-pt measurements and back-gated transport analysis. Some preliminary 2pt results are shown in figure 1d. It is clear that at low boron concentrations, NWs have a lower resistivity than bare GaAs nanowires grown under similar conditions, and showed ohmic rather than rectifying behaviour. Due to the low bowing parameter of $B_xGa_{1-x}As$[2], the growth conditions considered here ($x < 0.004$) should lead to a negligible bandgap shift. Therefore, we attribute the change in conductivity to B dopant atoms, and hypothesize that boron clusters on the surface are conducive to forming ohmic contacts.

References

[1] Gupta et al., *Journal of Electronic Materials* **29** (2000) 1387-1391
[2] Hart and Zunger, *Physics Review B* **62** (2000) 13522
[3] The authors would like to thank the Austrian Science Fund (FWF): P26100-N27 (H2N) for funding. HD acknowledges financial support through an APART fellowship from the Austrian Academy of Sciences.