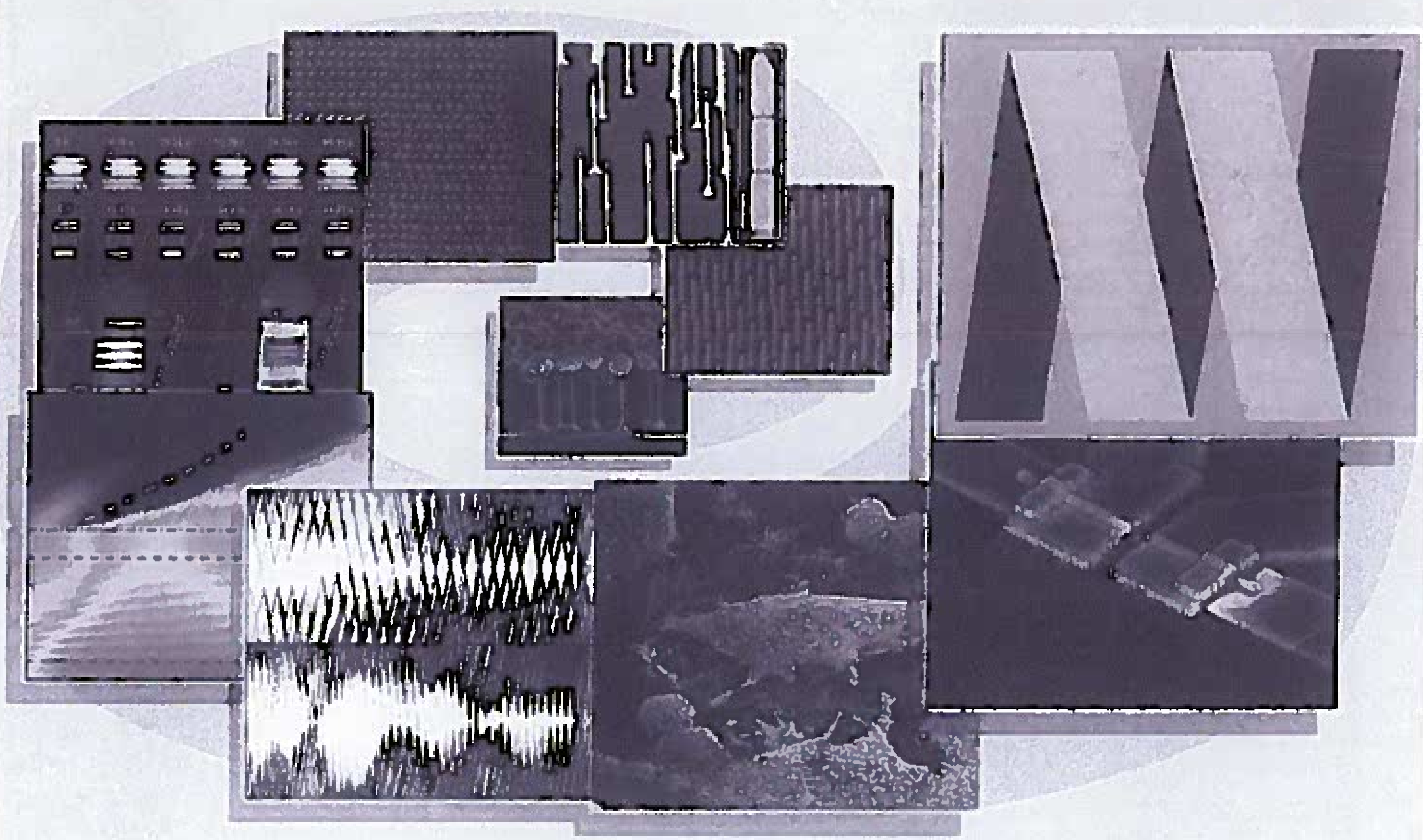
10th Nanowire Growth Workshop + 9th NANOWIRES

NANOWIRE WEEK 2017

May 29th - June 2nd, Lund, Sweden



Program

P2.34	**Mathieu Dechaux** UCA, CRHEA-CNRS, Valbonne and Clermont Université, Institut Pascal, Clermont-Ferrand, and CNRS, UMR 6602, Institut Pascal, Aubière, France *Lasing effect under optical pumping in single p-i-n core-shell GaN nanowires grown by metalorganic chemical vapor deposition*
P2.35	**Seyed Mohammad Mostafavi Kashani** Department of Physics, University of Siegen, Germany *Dynamics of annealing of GaAs nanostructures (nanowires and crystallites) by in-situ time-resolved X-ray diffraction*
P2.36	**Hermann Detz** Centre for Micro- and Nanostructures, Institute for Solid State Electronics, TU Wien, and Austrian Academy of Sciences, Austria *Growth of self-catalyzed GaAs nanowires via focused ion beam implantation*
P2.37	**Thomas Stettner** Walter Schottky Institut and Physics Department, Technische Universität München, Garching, Germany *GaAs-AlGaAs core-shell nanowire lasers on silicon*
P2.38	**Zhaoguo Xue** National Laboratory of Solid State Microstructures, Nanjing University, China and LPICM, CNRS, Ecole Polytechnique, Université Paris-Saclay, France *Engineering island-chain silicon nanowires via a droplet mediated Plateau-Rayleigh transformation*
P2.39	**Erik K. Mårtensson** Solid State Physics and NanoLund, Lund, Sweden *Side-by-side MOVPE study of GaAs nanowire growth using gold, silver and gold-silver alloys as seed materials*
P2.40	**Diana Car** Department of Applied Physics, Eindhoven University of Technology and Kavli Institute of Nanoscience, Delft University of Technology, The Netherlands *InSb nanowires with built-in $Ga_xIn_{1-x}Sb$ tunnel barriers for Majorana devices*
P2.41	**Simone Assali** Department of Engineering Physics, École Polytechnique de Montréal, Canada *Structural and optical properties of SiGeSn nanowires*
P2.42	**Thomas Cossuet** Université Grenoble Alpes, CNRS, France *Polarity-dependent selective area growth of ZnO nanowires by chemical bath deposition*
P2.43	**Tomáš Pejchal** CEITEC – Central European Institute of Technology, Brno University of Technology, Czech Republic *Group III catalysts: preparation and Ge nanowire growth*
P2.44	**Suneel Kodambaka** Solid State Physics and NanoLund, Lund, Sweden and Department of Materials Science and Engineering, University of California Los Angeles, United States *Kinetics of Au-catalyzed evaporation of GaAs nanowires*
P2.45	**Daniel Ruhstorfer** Walter Schottky Institut and Physics Department, Technische Universität München, Garching, Germany *Size-, defect- and disorder-mediated quantum confinement phenomena in GaAs-based nanowires*
P2.46	**Mahtab Aghaeipour** Solid State Physics and NanoLund, Lund, Sweden *Enhanced light-trapping in InP nanowires*
P2.47	**Xulu Zeng** Solid State Physics and NanoLund, Lund, Sweden *GaInP/InP nanowire tunnel diodes for tandem solar cells*
P2.48	**Chalermchai Himwas** Centre de Nanosciences et de Nanotechnologies, CNRS, Univ. Paris-Sud, France *Catalyst-free GaAsP/GaP core/shell nanowires for tandem solar application*
P2.49	**Genziana Bussone** Beamline P08, PETRA III synchrotron, DESY, Hamburg, Germany *Synchrotron X-ray diffraction on ensemble and individual core/shell $GaAs/In_xGa_{1-x}As$ nanowires at beamline P08 – PETRA III (DESY)*
P2.50	**Marie-Ingrid Richard** Aix-Marseille Université, CNRS and ESRF, The European Synchrotron, Grenoble, France *Intermixing in single Ge-Si core-shell nanowires: a coherent X-ray imaging study*

Growth of self-catalyzed GaAs nanowires via focused ion beam implantation

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Keywords: Positioned growth, focused ion beam lithography, self-catalyzed growth.

Positioned nanowire growth is widely researched as a necessary step to the integration of nanowires in a wide range of devices, from solar cells[1] to transistors[2]. While this is currently achieved through methods such as nanoimprint lithography[3] or e-beam lithography, we wanted to remove the need for a mask and the subsequent cleaning required for transfer of the sample into an ultra-high vacuum environment. To that end, GaAs nanowires were grown via a self-catalyzed method[4] on array points defined by focused ion beam (FIB) lithography. In this method, Ga+ ions are implanted at defined array points in the FIB system, and after a 600°C anneal these form nucleation points for nanowires grown via molecular beam epitaxy (MBE). The yield of the growth sites was seen to vary with implantation and growth parameters[5] up to a maximum of 82% for nanowires grown on Si(111) at a FIB implantation voltage of 5kV. In general, high yields were achieved via low implantation voltages and high implantation doses.

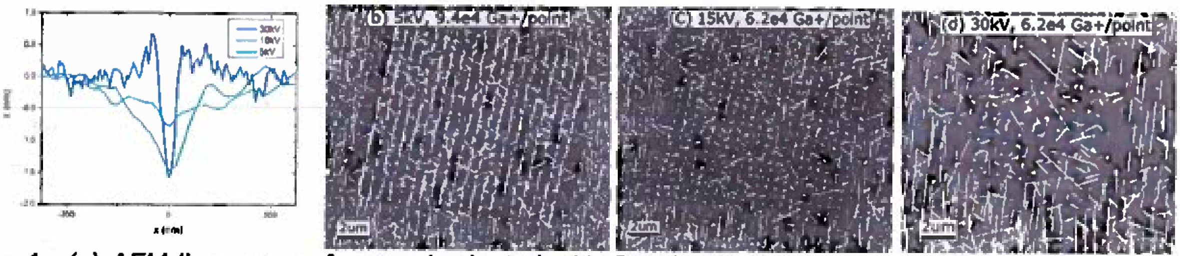

Figure 1. *(a) AFM line scans of arrays implanted with Ga+ ions via a focused ion beam at 5kV, 15kV and 30kV. SEM images of nanowire growth on arrays implanted with Ga+ at (b) 5kV, (c) 15kV and (d) 30kV.*

In order to understand why these conditions lead to an improved yield, the substrate after implantation was characterized via atomic force microscopy (AFM, fig. 1a), and the results were compared with droplet nucleation rates and eventual wire growth (fig. 1b-d). It was found that in our current configuration, low-acceleration beams were defocused (fig. 1a), hence necessitating a higher implantation dose. The additional consequence of this beam defocusing was an elongation of the implanted area, leading to parasitic growth (fig. 1b). Conversely, highly focused beams led to a large sputtering depth and subsequent poor growth (figs. 1c & d). Clearly, a trade-off in these conditions is needed to improve yield and uniformity of nanowires positioned using this method.

References

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[3] Mårtensson et al., *Nano Letters* **4** (2004) 699-702
[4] Jabeen et al., *Nanotechnology* **19** (2008) 275711
[5] Detz et al., *Journal of Vacuum Science & Technology B* **35** (2017) 011803
[6] 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.