



Myfab Report 2016

Myfab - The Swedish Research Infrastructure for Micro and Nano Fabrication

www.myfab.se

Myfab, the Swedish Research Infrastructure for Micro and Nanofabrication enables about 850 researchers and entrepreneurs to carry out their nano visions. With more than 700 tools strategically located in cleanroom laboratories at Sweden's four leading nanotechnology universities, we offer charge based user access with practically no waiting time to experienced and new users, from academy and industry. Myfab's clean-room staff and expertise serves the users by developing and maintaining processes and tools, and by holding educational courses, process advice and support.

Myfab is the place where synthesis – or creation – of new materials, structures, devices and miniaturized systems on the nanoscale are made. It is the birthplace of ideas and the playground for their realization. Myfab is the starting point for value chains, where devices are integrated as key enabling components in a system. It could be transistors for world leading low-noise or high power amplifiers, detectors for infrared light or superconducting quantum interference devices (SQUID), which enable neurologists to “look” into the human brain or form the essential building block for future quantum computers.

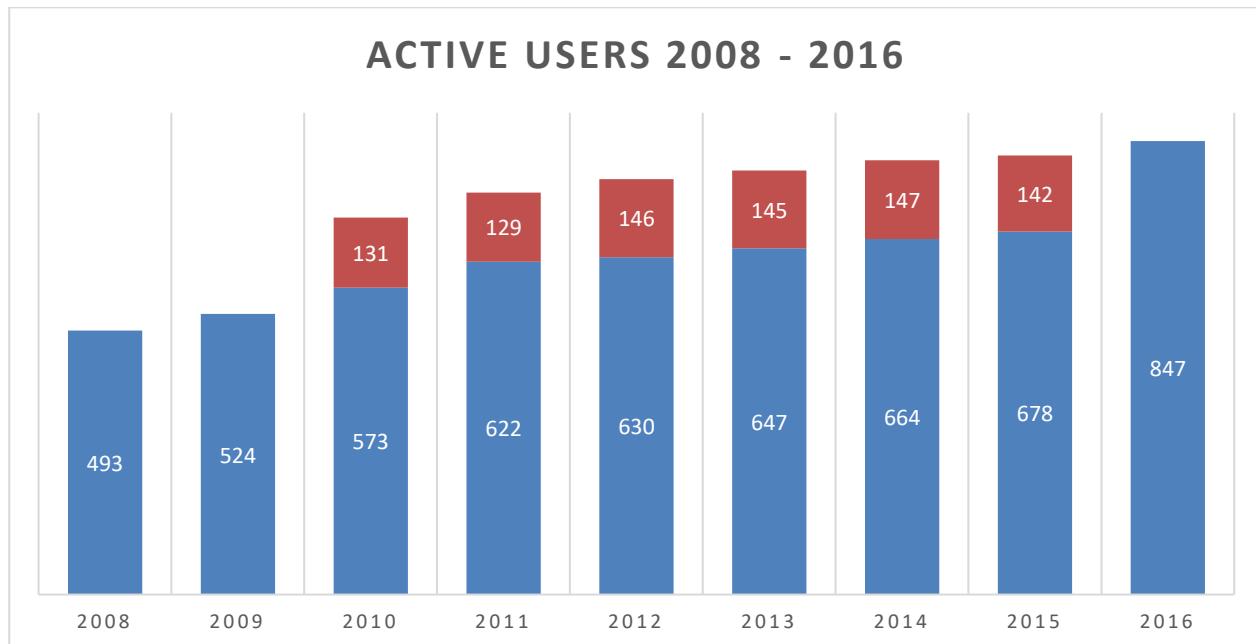
Myfab's distributed research infrastructure (RI) offers both the flexibility that is needed to advance state-of-the-art in science and technology, as well as a quality assured environment for small and medium size manufacturing for spin-off companies and Small and Medium Sized Enterprises (SMEs). Today approximately 100 companies use Myfab, and typically during a 5-year period, typically 20 – 30 start-ups emerge from the environment.

The academic output from the Myfab environment is amazing: Myfab's user community produced 3400 peer-review publications during a 5-year period, and every year, about 50 persons finalize their PhD studies within Myfab. Myfab has set the standard in Europe for efficient user access, follow-up and planning through our operations practices supported by the tailor-made Myfab LIMS system. Myfab LIMS itself, is continuously developed through a community formed by Myfab and five other national RI's in Finland, Norway, Ireland, France and Portugal.

The network has been further developed at the Nordic level by the establishment of the Nordic Nanolab Network, which encompasses collaboration at the management-, expert- and user levels in all five Nordic Countries. Improvements and development in science and technology as well as education are boosted through the Nordic Nanolab Expert Network, where experts from approximately 20 Nordic clean-room laboratories meet and exchange best practices and experiences, which are implemented in the different laboratories. We are building a really strong network promoting synergies and mobility, through lowered thresholds, streamlined and open user access, for the benefit of Sweden's competitiveness on the international arena.

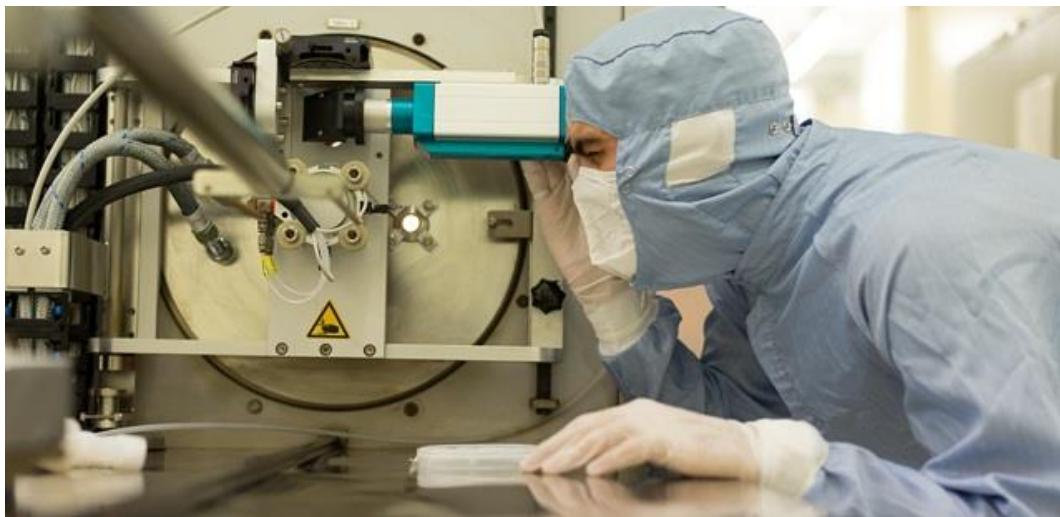
Myfab – the focal point of the nation's efforts

Being Sweden's national research infrastructure for microtechnology and nanoscience, Myfab attracts a vast majority of Sweden's micro- and nanotechnology researchers and entrepreneurs within a wide range of fields. Compared to the first year when Myfab LIMS was introduced at all Myfab laboratories (2008), the number of active users has increased monotonically since then, as presented in the table below.



Active Myfab users 2008 – 2016. Users at Lund Nano Lab are represented in red on top of the Myfab columns during the period they used Myfab LIMS without being part of Myfab (2010 – 2015). LNL is included (full year) in the Myfab data for 2016.

In 2016, 716 (84.5 %) users come from academia and 131 (15.5 %) were commercial users from either industry or research institutes. Myfab annually serves approximately 100 companies. The total number of booked tool-hours was 199182. New and potentially returning users, with no previous experience from Myfab, are invited to apply for funding for their first project through *Myfab Access*.



NEW PERIOD OF OPERATION 1 APRIL 2016 – 31 DECEMBER 2019

Myfab entered its fourth period of operation on 1 April 2016, and from this date, Lund Nano Lab has been a full member of the infrastructure. Despite the expansion of Myfab from three to four laboratories, the operations grant from the Swedish Research Council has decreased significantly (from 31 MSEK to 17 MSEK annually). Furthermore, from 1 July 2016 Myfab has a new steering board from 1 July 2016 and during 2016 there has been changes of members in the owner group and operational management as well.

ORGANISATION

Myfab's owner group

Myfab is a joint undertaking of four universities: Chalmers University of Technology, KTH Royal Institute of Technology, Lund University and Uppsala University. Each university owns the local cleanroom laboratory. The owner group has been formed in order to address matters where Myfab's undertakings and the University's strategy overlap. The participating universities collaborate according to the Consortium Agreement, and according to the Main Contract between the host university (Chalmers) and the Swedish Research Council (SRC).

Representing Chalmers:	1 January – 30 June: Professor Dag Winkler 1 Jul: Professor Mikael Fogelström
Representing KTH:	Professor Carl-Mikael Zetterling
Representing Uppsala University:	Professor Mikael Jonsson
Representing Lund University:	from 1 April: Doctor Anneli Löfgren



Myfab's steering group

The members of Myfab's steering group from 1 January to 30 June 2016 were Ludvig Edman (Prof. Physics, Umeå University), Håkan Engqvist (Prof. Applied Materials Science, Uppsala University), Per-Erik Hellström (Assoc. professor Solid-State Electronics, KTH), Hans Hentzell, CEO Swedish ICT (chairman), Susanne Holmgren (Prof. Emerita Zoophysiology, University of Gothenburg), and Nils Mårtensson (Prof. Physics, Uppsala University).

From 1 July, the steering group consists of the following members:

Anne Borg, (Prof. Physics NTNU, Norway), Hans Hentzell, (chairman), Susanne Holmgren (Prof. Emerita Zoophysiology, University of Gothenburg), Anneli Löfgren, (Admin. Research Director Lund Nano Lab), and Jonas Wallberg, (Director ICT, the Association of Swedish Engineering Industries, Teknikföretagen).

Operational management

Myfab's operation is managed by the Director Thomas Swahn in collaboration with the laboratory managers Ivan Maximov (Lund University), Peter Modh (Chalmers), Stefan Nygren (Uppsala University) and Nils Nordell (KTH). Cristina Andersson, Chalmers, acts as support systems officer and project manager.

Myfab LIMS

A large part of the 2016 effort on Myfab LIMS has been the work on a specification for a new module that will support documentation of process flows and logging during execution of these flows. This module will increase the spread of process knowledge and simplify sharing and access to process modules at other nodes. During the fall the first parts of this module was implemented. To facilitate a modern user interface, we have upgraded the server hardware and software and adapted our old code. During 2017, this new module will be integrated with our existing code and this alpha-version will be tested out.

In parallel we have continued the development of the existing platform and implemented around 60 additions or changes to the software. Lund NL has been fully synchronized with the three previous nodes in Myfab. The user base is still increasing, Myfab LIMS is now used in 12 major cleanrooms in Europe (including Sweden) and we are preparing another three nodes to be launched in 2017 and more are interested.

MYFAB'S FOUR CLEANROOM LABORATORIES

Myfab Chalmers – Nanofabrication Laboratory

During 2016 we have commissioned a new e-beam lithography system, partially funded by KAW. This addition will strengthen our infrastructure in nano-lithography. We are now in a fast ramp up of users and besides academic interest the new lithography capabilities attracts more commercial customers. We have commissioned anew Black Magic for graphene and boron nitride. With this tool we can separate the CNT growth to be done in the old Black Magic

and all graphene to be grown in this new tool. This will improve the quality for both material systems.

The reduced financial support from SRC has forced NFL to set up a plan for the upcoming years that will result in a reduced staff (reduction due to retirements not replaced). This means that in 2019 the NFL staff will be 18 FTE instead of the present 20.5. The financial plan relies on an increased support from Chalmers as well as an increase in user fees.

Myfab Lund – Lund Nano Lab

The new ICP-RIE etching tool (Plasma-Therm) has been delivered and installed at LNL in December. This equipment has been funded from the Research Infrastructure Fellow SSF grant, NanoLund and the Faculty of Engineering (LTH) of Lund University. The Trion T3, another reactive etching tool has been upgraded with a new pumping system. This new equipment and the update of the existing tool will strengthen the LNL dry etch capability.

A table-top high-resolution sputter coater, co-financed by Kungliga Fysiografiska Sällskapet in Lund and NanoLund replaced a similar old instrument. Finally, the SSF's Research Infrastructure Fellow grant partially funded the modification of the nanoimprint tool with a new UV-LED illumination source to improve reproducibility of the imprint process.

The funding provided by SSF made it possible for the lab to recruit a new research engineer with responsibility of service, repair and maintenance of several lab tools. At the same time it allowed two of the lab engineers to be involved in the development of nanolithography competence via EU-project NFFA-Europe.

At the end of October, Lund Nano Lab, together with Raith GmbH, Germany organized the 1-st Scandinavian Raith EBL User Meeting in Lund with 16 participants from Sweden, Denmark and Finland.

After the decision by the NanoLund management to move to Brunnshög area, close to MAX IV and ESS, the lab staff started a systematic work to specify parameters and layout of the new LNL.

Myfab KTH – Electrum Laboratory

A refurbished Nikon TFHi12 i-line stepper for 100, 150 and 200 mm diameter wafers is installed and the process is established.

Industrial partners at the laboratory have installed a new Flip-Chip tool and a reactor for epitaxial growth of SiC.

The SSF grant to Nils Nordell as Research Infrastructure Fellow for development of a process for CMP (Chemical Mechanical Planarization) allowed specification and procurement of a CMP tool, which was delivered in November.

The first phase of the EU financed CAMART2 project was finished and an application was submitted for the second phase. This phase will be funded with 15 MEuro during a period of 7

years, beginning in 2017, to develop education, research, open access laboratories, and an innovation system at Institute of Solid State Physics at University of Latvia. KTH and RISE Acreo will participate in a consulting role as partners from advanced countries.

The event “Future Friday”, where high school students visit KTH-ICT to learn about the possibilities opened by an education in information technology attracted more than 2000 visitors and 160 joined the Electrum Lab tour.

Electrum Lab met the demands from the major commercial users on particle and climate control, and on increased capacity of house gas deliveries; masks are now compulsory in the cleanroom, tools are moved to certify a cleaner environment and a new delivery system for hydrogen will be installed.

The economic situation is stable at the Electrum Laboratory, mainly due to the high level of industrial usage, the Research Infrastructure Fellow grant from SSF and the EU financed CAMART2 project.

Myfab Uppsala - Ångström Microstructure Laboratory

New tools for TEM and XPS were delivered during 2016 and procurement of a new ALD has been initiated. In order to make the EBL system more versatile and useful for a greater variety of materials systems, an ion beam etcher is being built and should be ready for installation early 2017. The development of hardware locks, controlled by bookings in Myfab LIMS, has proceeded during the past year. A TEM operator was hired in collaboration with the Solid State Electronics division. This should make TEM analysis more available to the Myfab users.

The faculty decided on a new model for the distribution of rental costs. This will reduce the cost for cleanroom space and make more funding available for renewal of the research infrastructure. A new board, with a broader representation within the faculty, has been selected. Both changes will be effective from 2017.

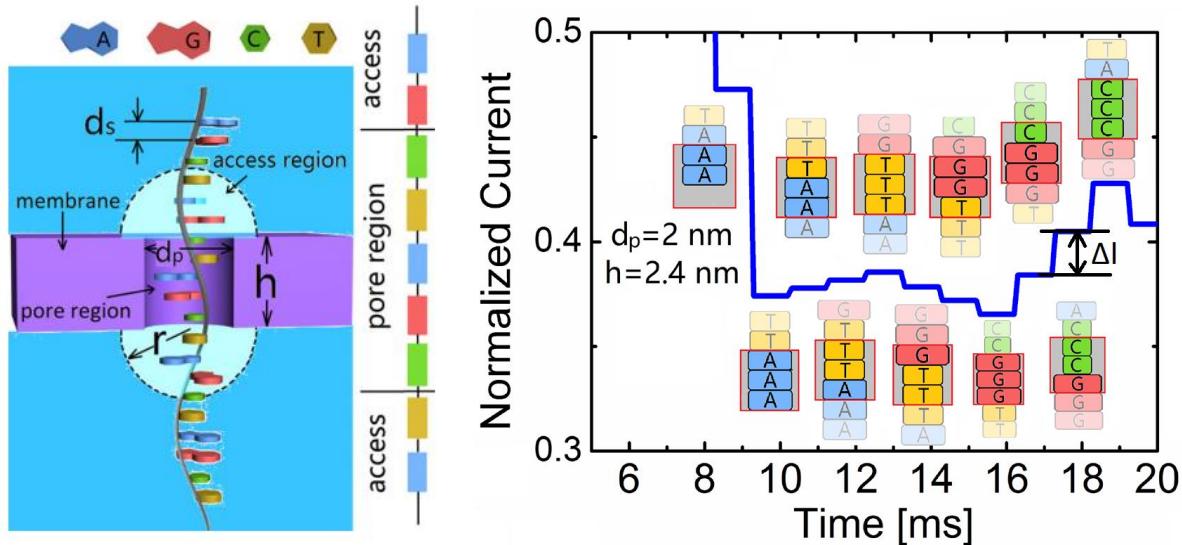
MYFAB ACCESS

Myfab offers new users the option to apply for free access to Myfab through the Myfab Access program. The aim is to give new user groups practical experience of using Myfab. Interested users should present a project proposal. Applicants must hold a position at a Swedish university/institute or SME, and should not have any previous experience of micro-nanofabrication at Myfab. The program has a tutorial and informative focus, and applicants are supported and informed about the possibilities with nanotechnology already in the application phase.

MYFAB SUCCESS

Myfab's users produces a very large scientific output in a broad range of scientific areas. Below are some examples – success stories from 2016 – we want to highlight.

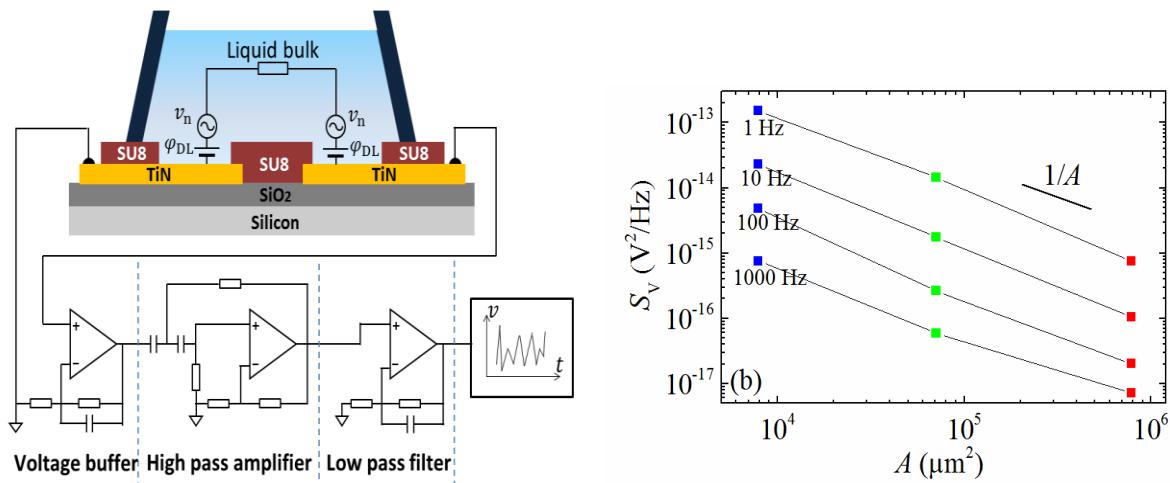
Nanopore technology for DNA sequencing



Nanopore technology holds great promise in cheap, fast and portable DNA sequencing applications. The research group at Uppsala University has employed a simple rigid-disc model to evaluate the signal (ΔI in the right figure above) and noise characteristics of solid-state nanopores for DNA translocation. The model predicts that determining the DNA sequence is extremely demanding and novel signal enhancement strategies need to be incorporated in order to achieve the ultimate goal of single base resolution.

Chenyu Wen, Shuangshuang Zeng, Zhen Zhang, Klas Hjort, Ralph Scheicher, Shi-Li Zhang. On nanopore DNA sequencing by signal and noise analysis of ionic current. *Nanotechnology* 27 (2016) 215502 (12pp).

Direct assessment of solid-liquid interface noise



The noise generated in liquid as well as at the solid-liquid interface has been poorly characterized for ion sensors operating in electrolytes. The research group at Uppsala University has therefore developed a novel microelectrode cell dedicated to direct assessment

of the interface noise. Current design uses two identical TiN electrodes of various sizes for differential measurements in KCl-based electrolytes. Measured noise of the TiN-electrolyte system is found to be of thermal nature. Scaling inversely with electrode area, the noise is concluded to mainly arise from the solid-liquid interface. This noise is comparable to or larger than that of the state-of-the-art MOSFETs. Hence, its influence cannot be overlooked for design of future ion sensors.

Da Zhang, Indrek Must, Nathan L. Netzer, Xingxing Xu, Paul Solomon, Shi-Li Zhang, Zhen Zhang. Direct assessment of solid–liquid interface noise in ion sensing using a differential method. *Appl. Phys. Lett.* 108 (2016) 151603.



An artist's impression of the completed Phase 1 of the SKA in South Africa's Karoo Desert. SKA Organisation

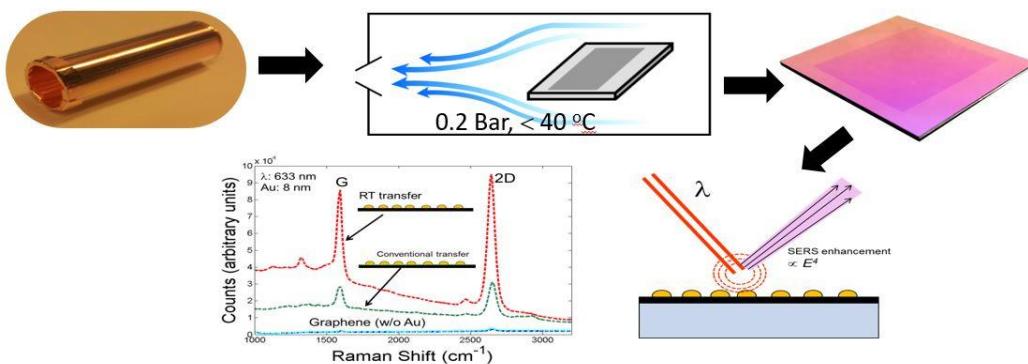
Sweden's biggest contribution yet to the world's largest radio telescope

Sweden's biggest contribution yet to the world's biggest radio telescope, the Square Kilometre Array (SKA), has passed a major milestone. An advanced – and beautiful – feed horn developed at Chalmers University of Technology, has been delivered for testing in Canada. The amplifiers for the feed horn have been specially developed for this project by the Gothenburg-based company Low Noise Factory in collaboration with Onsala Space Observatory and the GigaHertz Centre at Chalmers.

<http://www.chalmers.se/en/centres/oso/news/Pages/Swedens-biggest-contribution-yet-to-the-worlds-largest-radio-telescope.aspx>

Schleeh, J., Wadefalk, N., Nilsson, P. & Grahn, J. (2016) 10 K Room Temperature LNA for SKA Band 1. *IEEE MTT-S International Microwave Symposium Digest. 2016 IEEE MTT-S International Microwave Symposium, IMS 2016, San Francisco, United States, 22-27 May 2016*

Graphene growth and transfer technologies



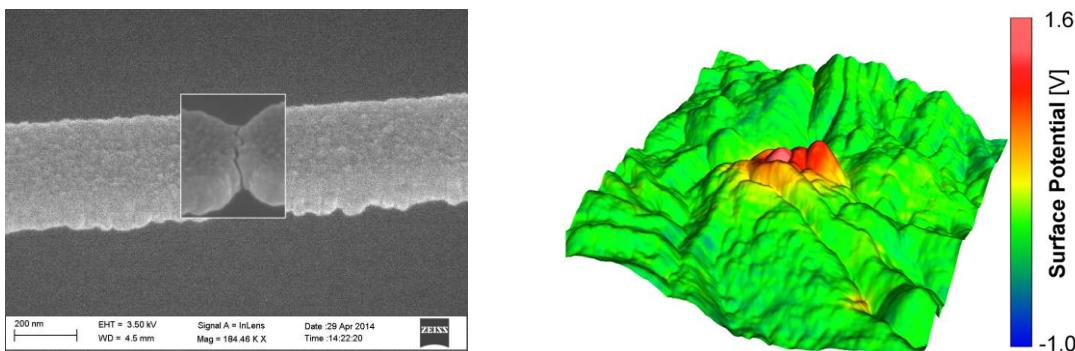
Conventional polymer-assisted transfer of graphene is prone to unwanted polymer contamination. Researchers of Uppsala University have devised a new transfer method that leads to high-quality graphene free of polymer contamination. They have further established a new characterization technique, supported by theoretical simulations, based on surface-enhanced Raman scattering, to evaluate the cleanliness of a graphene surface at sub-nanometre resolution.

Malkom Hinnemo, Patrik Ahlberg, Carl Hägglund, Wencai Ren, Hui-Ming Cheng, Shi-Li Zhang, Zhi-Bin Zhang. Scalable residue-free graphene for surface-enhanced Raman scattering. Carbon 98 (2016) 567.

Crack-junctions: Technologies towards molecular-level electronics on wafer-scale

Researchers at KTH have developed a new way of manufacturing electrodes separated by nanoscale gaps, so called crack-junctions. The technique is based on the controlled formation of nanocracks in free-standing beam structures. Each crack-junction can be pre-programmed to yield any electrode separation from sub-5 nm to 100 nm and above. The method is reproducible and compatible with conventional wafer-scale optical lithography, thus paving the way towards molecular-level electronics on wafer-scale.

Dubois, V., Niklaus, F. and Stemme, G. (2016), Crack-Defined Electronic Nanogaps. Adv. Mater., 28: 2178–2182. doi:10.1002/adma.201504569



Electrodes separated by a crack junction (left) and surface potential plot (right) as a result of a new AFM-based technique

Unique nano-material analysis developed based on Atomic Force Microscopy

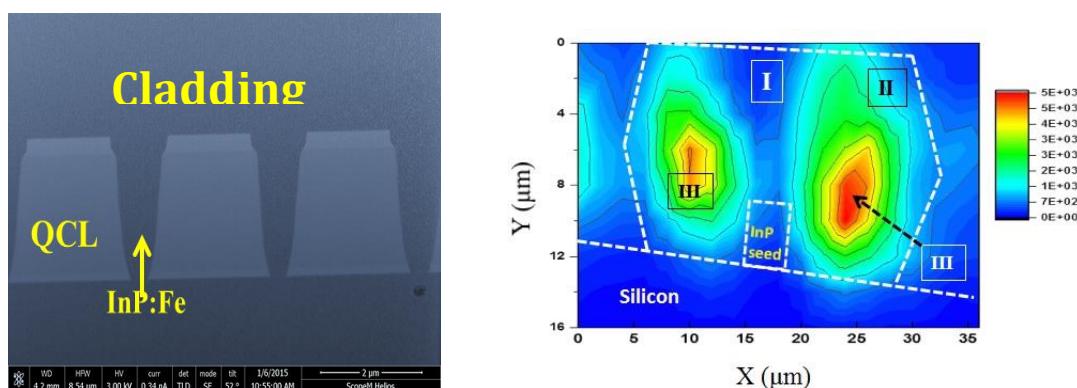
High voltage direct current (HVDC) cables are important for the efficient transmission of electricity from distant sources to consumers. They are a key component of a future grid for the distribution of energy to a sustainable society. Transmission over longer distance and at higher capacity necessitates improvement in the electrical insulation material, enabling operation at voltages as high as one million Volts. It is believed that this will be possible by doping polymer insulation materials such as polyethylene, with nano particles of SiO₂ and Al₂O₃. However, the basic physical mechanism for the improved insulation characteristics is not fully understood. A collaboration between Polymer and Fiber Technology and Nanostructure Physics at KTH has used new methods of Atomic Force Microscopy to image charge trapping around individual nano-particles. The experiments provided experimental verification of theoretical ideas, giving deeper understanding and leading to further optimization of the material for HVDC applications.

Nano Lett. 2016, 16, 5934–5937. DOI: 10.1021/acs.nanolett.6b02920

Hydride Vapour Phase Epitaxy Facilitates Room Temperature Operation of Buried Heterostructure Photonic Crystal Quantum Cascade Lasers

In an FP7 EU project - 317884, MIRIFISENS (Mid InfraRed Innovative lasers For Improved SENSOR of hazardous substances), KTH team has successfully demonstrated in collaboration with Prof. Jérôme Faist's team at ETH, Zurich, that Hydride Vapour Phase Epitaxy (HVPE) can be used to fabricate buried heterostructure photonic crystal quantum cascade lasers that can be operated at room temperature.

Romain Peretti, Valeria Liverini, Martin J. Süess, Yong Liang, Pierre-Baptiste Vigneron, Johanna M. Wolf, Christopher Bonzon, Alfredo Bismuto, Wondwosen Metaferia, Manavaimaran Balaji, Sebastian Lourdudoss, Emilio Gini, Matthias Beck, and Jérôme Faist, Room temperature operation of a deep etched buried heterostructure photonic crystal quantum cascade laser, *Laser, Photonics Rev.* 10, No. 5, 843–848 (2016) / DOI 10.1002/lpor.201600047



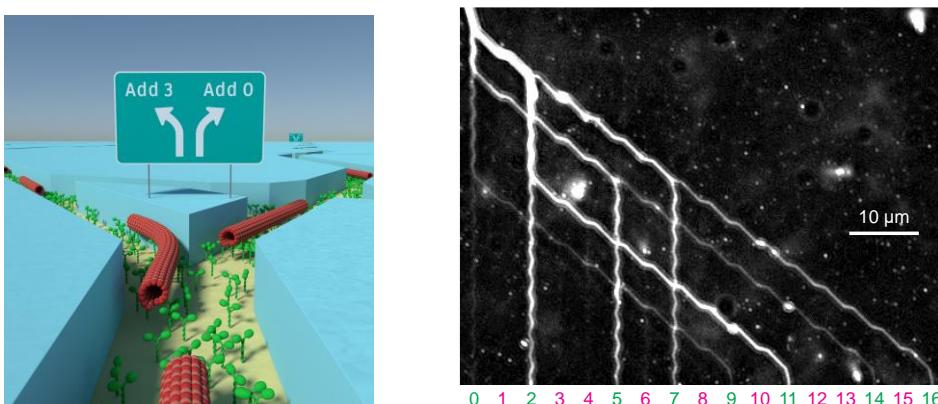
Heterostructure photonic crystal (left) fabricated using Hydride Vapour Phase Epitaxy (HVPE)c, and Photoluminescence intensity contour (right) of the cross-section of CELOG GaInP/Si at peak wavelength of 765 nm. Region III has the highest intensity which indicates high crystalline quality of GaInP near the interface with Silicon.

Parallel computer based on molecular motors

Myfab capabilities in electron-beam lithography (EBL) and surface modification have been used for several years to develop devices that can guide and control the motion of cytoskeletal filaments, such as actin, powered by molecular motors, such as myosin.

Based on this long-term effort, a novel concept for parallel computing based on molecular motors was recently established. EBL was used to define a designed network, or “labyrinth” of guiding channels that encodes a specific instance of a NP-complete mathematical problem. Filaments “solve” the problem in a massively parallel manner by exploring all possible paths through the network. The approach is, in principle, scalable and highly energy efficient: to perform one mathematical operation, the molecular motors require about 1000 less energy than a transistor.

The research was published in PNAS 113, 2591-2596 (2016) and has resulted in a major, 5-year, 6.1 M€ Horizon 2020 FET project Bio4Comp coordinated by Lund University, and partnering with Linnaeus University.

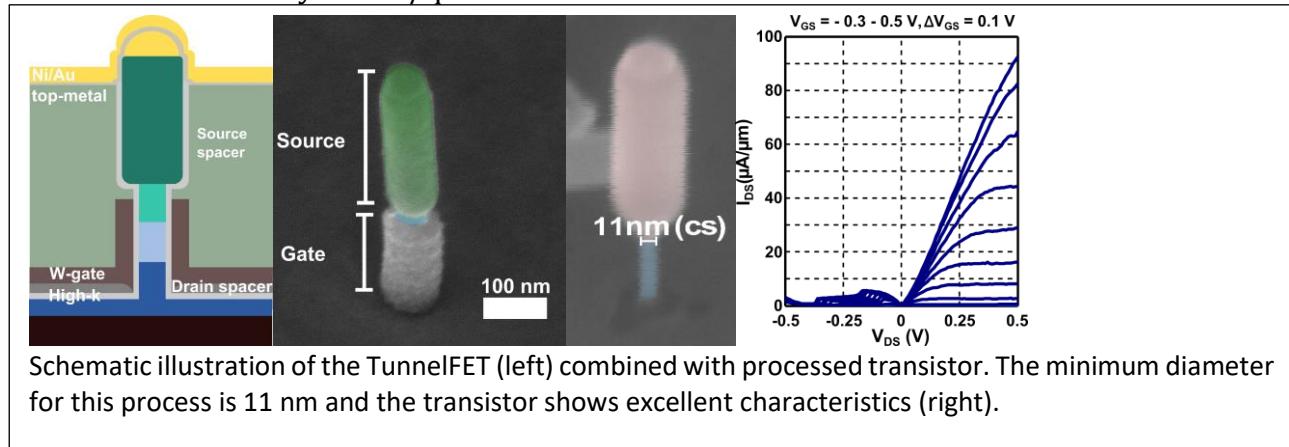


Dan V. Nicolau, Jr., Mercy Lard, Till Kortend, Falco C. M. J. M. van Delft, Malin Persson, Elina Bengtsson, Alf Månnsson, Stefan Diezd, Heiner Linke, and Dan V. Nicolau, Parallel computation with molecular-motor-propelled agents in nanofabricated networks, PNAS 113, 2591-2596 (2016)

Processing of Vertical TunnelFETs operating below kT/q

The process facilities within Lund Nano Lab has been used to fabricate vertical InAs/GaAsSb/GaSb nanowire Tunnel Field-Effect Transistors that operate with a subthreshold swing below the fundamental thermal limit of 60 mV/dec. (kT/q). The complex nanowire heterostructure has been grown by MOVPE using the VLS growth method and nanowire transistors with channel diameters of about 20 nm fabricated by the use of digital etching (cyclic oxidation and oxide removal) to trim the dimensions. The complete transistor has been proceed using a bi-layer of Al₂O₃/HfO₂ as gate dielectric deposited by ALD with a sputtered W gate electrode. The gate has been aligned to the nanowire heterostructure vertically by using an HSQ spacer layer at the bottom (drain spacer) where the thickness of the spacer is defined by the E-beam exposure to an accuracy of about 10 nm. The transistor is then completed by deposition of a source spacer at the top and a Ni/Au top metal. Using this process flow, transistor channels down to 11 nm diameter has been demonstrated and further improvement in the etching technology provides currently 6 nm nanowires in transistor structures. The

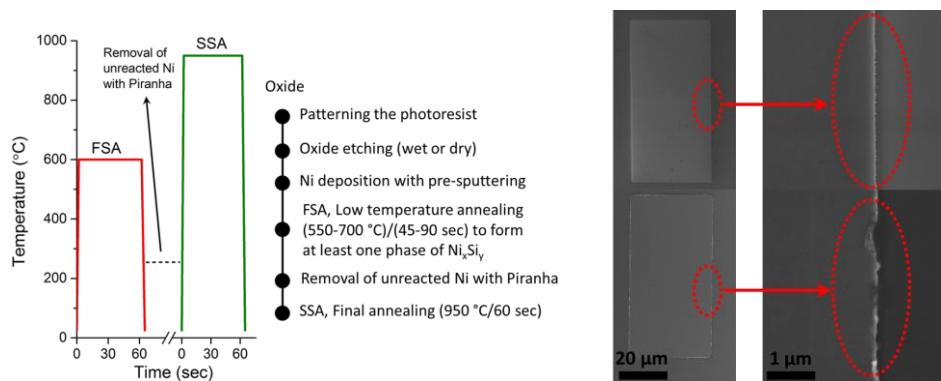
transistors have been characterized electrically and they provide a drive current of about 10 $\mu\text{A}/\mu\text{m}$ at $V_{ds}=0.3\text{V}$, exceeding the values of state-of-the-art Si FinFET and SOI foundry technology at the 16 and 20 nm nodes, respectively. The data was presented at IEDM 2016 as a selected conference highlight and the technology is a key for the VR Research Environment Grant “Electronics beyond kT/q”



E. Memisevic, et. al., “Vertical InAs/GaAsSb/GaSb Tunneling Field-Effect Transistor on Si with $S=48$ mV/decade and $I_{on} = 10 \mu\text{A}/\mu\text{m}$ for $I_{off}=1\text{nA}/\mu\text{m}$ at $VDS=0.3\text{ V}$ ”, in Proc. Int. Electron Device Meeting (IEDM), Dec. 2016, 500-503.

Wafer-Scale Ni-SALICIDE Contact Technology on n-Type 4H-SiC

Researchers at KTH have developed a wafer-scale Ni-SALICIDE contact technology on n-type 4H-SiC. The method is based on a low temperature annealing (FSA), removal of unreacted Ni, and a final high temperature annealing (SSA) to form a low-resistive Ohmic contact. The developed process is reproducible, clean with no metal residue or jagged edge, simple, and suitable for wafer-scale industrial applications due to elimination of the conventional lift-off process.

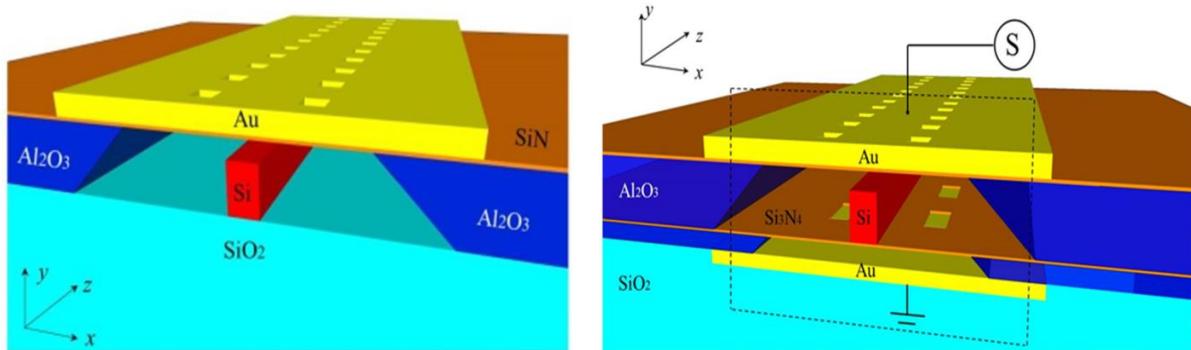


H. Elahipanah, A. Asadollahi, M. Ekström, A. Salemi, C.-M. Zetterling, and M. Östling, “A Wafer-Scale Ni-SALICIDE Contact Technology on n-Type 4H-SiC,” *ECS J. Solid-State Sci. Tech.*, vol. 6, no. 4, pp. 197–200, March 2017.

Hollow Hybrid Plasmonic Structures for Sensor and Modulator Applications

We have mastered technology for single and double slot hybrid plasmonic hollow structures, where the empty space can be infiltrated by tested liquids for high sensitivity sensor

applications or by electro-optic polymer for high-speed modulators. The structures are very small with sub-wavelength light confinement in 70nm thick gap. This work was recognized with the “Best Conference Paper Award” at the Asia Communication and Photonics Conference (ACP 2016), Wuhan, China and also published in Optics Letters.



Hybrid plasmonic sensor with sensitivity 245 nm/RIU and detection limit of 2.8×10^{-6} RIU [1]

Hybrid plasmonic phase modulator with VL product of 0.3 Vmm and prop. loss 0.35dB/ μ m [2]

[1] X. Sun, L. Thylen and L. Wosinski, “Hollow Hybrid Plasmonic Mach-Zehnder Sensor”, Opt. Lett. 42(4), pp. 807-810 (2017). [2] X. Sun, L. Thylen and L. Wosinski, “Hollow Hybrid Plasmonic Waveguide Used for Electro-optic Phase Modulation”, presented at the Asia Communication and Photonics Conference (ACP 2016), Wuhan, China, Nov. 2-5, 2016.

INTERNATIONAL COLLABORATION

Myfab's international collaboration has continued to develop well during 2016. Especially important is the collaboration within the Nordic Nanolab Network (NNN, <http://nordicnanolab.net>), which comprises collaboration on three levels: management, expert and user. In May 2017, the first Nordic Nanolab User Meeting (NNUM) will be arranged, which is the joint user meeting for all Nordic nanofabrication research infrastructures. The NNUM focus on presenting state of the art nanofabrication techniques, and the core part of the program consists of technical tutorials organized and given by the experts of the Nordic Nanolab Expert Network (NNEN). The NNUM is scheduled as a biennial event. The NNEN has formed Nordic expert groups in five important areas: Dry Etching, Thin Film, Lithography, Characterization and Facility Operation. More than twenty experts within each of these areas meet, exchange best practices and interact electronically between meetings.

Myfab is also part of EuroNanoLab (<http://euronanolab.net>), which is an initiative by the research infrastructures for micro- and nanofabrication of Denmark (DTU Danhip/Cen), France (RENATECH), the Netherlands (NanoLab NL), Norway (NorFab), Germany (KIT), Sweden (Myfab), Czech Republic (CEITEC), and Portugal (International Iberian Nanotechnology Laboratory). EuroNanoLab was during 2016 investigating the possibilities to establish itself on the ESFRI roadmap.

ECONOMY

Myfab's financial report for 1 April – 31 December 2016, submitted separately and undersigned by Chalmers financial controller, has been approved by the Swedish Research Council. The report presents how the Myfab operations grant has been distributed, in accordance with the decisions taken by Myfab's steering group.

The table below present the total economy of the Myfab laboratories and sets the Myfab operation grant in perspective to each laboratory's total economy. The Myfab grant in this table represent the full-year 2016.

Income [kSEK]	Myfab Chalmers	Myfab KTH	Myfab Lund	Myfab Uppsala	Myfab all four labs
Faculty grants	25 389	12 500	10 705	10 443	59 037
Fees, academic	16 306	15 246	11 365	8 118	51 035
Fees companies incl. Acreo	4 510	18 247	4 875	3 195	30 828
Myfab SRC grant	5 224	4 874	1 758	4 874	16 730
Financed depr.	11 500	1 509	6 774	4 783	24 566
Services		4 760			4 760
Income Total	62 929	57 136	35 477	31 413	186 955
Costs [kSEK]					
Personnel	16 049	12 732	9 704	7 037	45 522
Rent premises	17 351	9 659	5 794	13 172	45 976
Operation	14 422	22 287	8 945	4 302	49 956
Overhead	4 910	5 461	3 562	1 338	15 271
Financed depr.	11 500	1 509	6 774	4 783	24 566
Depreciations	3 112	5 856	1 626		10 594
Costs Total	67 344	57 504	36 407	30 632	191 885
Result	-4 415	-368	-930	781	-4 930

ANNEX

- A. Standard report from Myfab LIMS – key numbers for Myfab 2016**
- B. Key numbers as specified from Appendix 1 (Bilaga 1) to Myfab's contract (Dnr: 2015-06030)**
- C. Publication lists from Publication lists from Myfab's laboratories at Chalmers, KTH Royal Institute of Technology, Lund University and Uppsala University**

ANNEX A

Standard report from Myfab LIMS – key numbers for Myfab 2016

	Myfab	Chalmers	KTH	Lund	Uppsala	2015 Myfab	2014 Myfab	2013 Myfab	2012 Myfab
Users with access	1592	441	490	273	388	1476	1412	1371	1337
Active users	847	213	217	147	270	820	811	792	776
Female active users	211	43	46	38	84	193	197	185	187
Gender balance, active users	25 %	20 %	21 %	26 %	31 %	24 %	24 %	23 %	24 %
University active users	716	193	164	125	234	695	672	651	641
Institutes active users	12	0	11	0	1	11	22	24	26
Commercial active users	119	20	42	22	35	113	117	116	109
Companies with own personnel	59	12	17	7	23	50	54	56	51
Number of booked hours	199182	61988	38313	57085	41796	192802	177732	185172	186744
-from universities	170858	58272	25187	49794	37606	166520	146940	155650	151480
-from institutes	3630	0	3619	0	10	3169	11636	13146	17346
-from commercial users	24694	3716	9507	7292	4179	23099	19155	16373	17918
Number of tools	701	191	228	83	199	687	658	634	612
Booked tools	399	141	106	62	90	407	381	386	388

ANNEX B

Key numbers as specified from Appendix 1 (Bilaga 1) to Myfab's contract (Dnr: 2015-06030)

1). Number of users per Myfab site, including other organisations, companies etc.

See the standard report in Annex A.

2). Number of users per scientific area (SCB-codes, on the 3-digit level)

Number of active users 2016:

		Chalmers	KTH	LU	UU	Myfab total
103	Physical Sciences	92	65	27	19	203
104	Chemical Sciences		9		48	57
106	Biological Sciences		2	12	8	22
202	Electrical Engineering	78	119	22	45	264
203	Mechanical Engineering			3	69	72
204	Chemical Technology	7	6			13
205	Materials Engineering	3			8	11
206	Medical Technology	1	3		12	16
209	Industrial Bio Technology	2	3			5
210	Nanotechnology	37	25	82	34	178
301	Basic Medicine				4	4
302	Clinic Sciences			1	1	2
304	Medical Biotechnology				22	22

3). Number of female and male users

Total number of active users 2016:	847
Total number of female users active 2016:	211 (25 %)
Total number of male active users 2016:	636 (75 %)

4). Average number of individuals that are connected to a group leader ("PI")

Not available from Myfab data. User affiliation normally recorded on department and division level.

5). Number of users per laboratory (i.e. active users 2016)

Myfab Chalmers	213
Myfab KTH	217
Myfab Lund	147
Myfab Uppsala	270

6). Number of users that has applied for access to the infrastructure but were not given access

No users were denied access.

Myfab applies open user access based on user-fees. The access model, according to "European Charter for Access to Research Infrastructures", European Commission (ISBN 978-92-79-456) is denoted Market-driven access. All users who are qualified, i.e. have the appropriate education and approval from an established research group (liable for all user charges), are given access to the infrastructure. Myfab gives regularly relevant clean-room and tool educations to its users.

7). Number of drivers licenses (individuals) that has passed the compulsory education and are allowed to use the laboratory, reported per laboratory

<u>Total number of uses with access:</u>	1592
Myfab Chalmers:	441
Myfab KTH:	490
Myfab Lund:	273
Myfab Uppsala:	388

8). Number of scientific publications and patents, published 2016 and to which the infrastructure has contributed

Number of scientific publications, (journal and conference papers) and PhD exams

	<u>Publications</u>	<u>PhD exams</u>
<u>Myfab total:</u>	811	53
Myfab Chalmers:	243	13
Myfab KTH:	161	14
Myfab Lund:	112	6
Myfab Uppsala:	295	20

Number of patents:

Myfab does not have information on user's patents, nor does Myfab require its users to report this kind of information.

ANNEX C

Publication lists from Publication lists from Myfab's laboratories at Chalmers, KTH Royal Institute of Technology, Lund University and Uppsala University

Myfab Publications 2016

Journal and Conference Papers

Chalmers – Nanofabrication Laboratory

1. Agnarsson, B., Wayment-Steele, H., Höök, F. & Kunze, A. (2016) Monitoring of single and double lipid membrane formation with high spatiotemporal resolution using evanescent light scattering microscopy. *Nanoscale* 8, nr. 46, s. 19219-19223.
2. Frost, R., Wadell, C., Hellman, A., Molander, S., Svedhem, S., Persson, M. & Langhammer, C. (2016) Core–Shell Nanoplasmonic Sensing for Characterization of Biocorona Formation and Nanoparticle Surface Interactions. *ACS Sensors* 1, nr. 6, s. 798-806.
3. Frost, R., Svedhem, S., Langhammer, C. & Kasemo, B. (2016) Graphene Oxide and Lipid Membranes: Size-Dependent Interactions. *Langmuir* 32, nr. 11, s. 2708-2717.
4. Lundgren, A., Agnarsson, B., Zirbs, R., Zhdanov, V., Reimhult, E. & Höök, F. (2016) Nonspecific Colloidal-Type Interaction Explains Size-Dependent Specific Binding of Membrane-Targeted Nanoparticles. *ACS Nano* 10, nr. 11, s. 9974-9982.
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7. Wayment-Steele, H., Jing, Y., Swann, M., Johnson, L., Agnarsson, B., Svedhem, S., Johal, M. & Kunze, A. (2016) Effects of Al³⁺ on Phosphocholine and Phosphoglycerol Containing Solid Supported Lipid Bilayers. *Langmuir* 32, nr. 7, s. 1771-1781.
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9. Fleischer, K., Ualibek, O., Verre, R. & Shvets, I. (2016) Formation of plasmonic nanoparticle arrays - rules and recipes for an ordered growth. *Physica Status Solidi B-Basic Solid State Physics* 253, nr. 2, s. 198-205.
10. Fritzsche, J., Albinsson, D., Fritzsche, M., Antosiewicz, T., Westerlund, F. & Langhammer, C. (2016) Single Particle Nanoplasmonic Sensing in Individual Nanofluidic Channels. *Nano letters* 16, nr. 12, s. 7857-7864.
11. Hakonen, A., Rindzevicius, T., Schmidt, M., Andersson, P., Juhlin, L., Svedendahl, M., Boisen, A. & Käll, M. (2016) Detection of nerve gases using surface-enhanced Raman scattering substrates with high droplet adhesion. *Nanoscale* 8, nr. 3, s. 1305-1308.
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13. Massiot, I., Trompoukis, C., Lodewijks, K., Depauw, V. & Dmitriev, A. (2016) Highly conformal fabrication of nanopatterns on non-planar surfaces. *Nanoscale* 8, nr. 22, s. 11461.
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