



European Materials Research Society

# Spring Meeting 2022

May 30 | June 3  
Virtual Conference

## SYMPOSIUM V

New trends in advanced lithography  
and pattern transfer methods

Symposium Organizers :

Flavio CARSUGHI, Forschungszentrum Jülich GmbH, Jülich  
Centre for Neutron Science at MLZ

Francesc PEREZ-MURANO, Institute of Microelectronics of Barcelona  
(IMB-CNM, CSIC)

Ivan MAXIMOV, Advanced Lithography Group, Lund Nano Lab, Division of Solid  
State Physics

Yasin EKINCI, Laboratory for Micro and Nanotechnology

To be published in ???



13:15	<b>Welcome and Introduction to the Symposium</b>		17:15	<b>Edge-contact MoS2 transistors made by thermal scanning probe lithography</b>	V 2.1
	<b>Presentation 1 : Yasin Ekinci, Ivan Maximov</b>			Ana Conde-Rubio, Xia Liu*, Giovanni Boero, Juergen Brugger Microsystems Laboratory, École Polytechnique Fédérale de Lausanne (EPFL), 1015 Lausanne, Switzerland	
13:30	<b>INV NFFA-Europe Pilot: a great research and innovation opportunity for the European and worldwide nanoscience community.</b>	V 1.1	17:15	<b>Flexible PMMA Stencil Lithography for 2D Materials Contacting</b>	V 2.2
	Flavio Carsughi Forschungszentrum Jülich, Germany			Xia Liu, Giovanni Boero, Juergen Brugger Microsystems Laboratory, École Polytechnique Fédérale de Lausanne (EPFL), 1015 Lausanne, Switzerland	
13:45	<b>INV Fully Automated Thermal Scanning Probe Lithography for FET Batch Fabrication</b>	V 1.2	17:15	<b>Fabrication and performance of graphene FETs based on single crystal flakes transferred from SiC wafers and a crosslinked PMMA</b>	V 2.3
	A. Knoll 1 , J. Chaaban 2 , N. Hendricks 2 , E. Cagin 2 , P. Nicollier 1 , H. Wolf 1 , D. Widmer 1 , U. Drechsler 1 1) IBM Research Europe – Zurich, Säumerstrasse 4, 8803 Rüschlikon, Switzerland 2) Heidelberg Instruments Nano AG, Bändliweg 30, 8048 Zürich, Switzerland			Sofia Aslanidou, Elif Ozceri, Alberto Garcia-Garcia, Philippe Godignon, Gemma Rius Institute of Microelectronics of Barcelona, IMB-CNM-CSIC (Spain)	
14:15	<b>Towards the fabrication of Silicon Nanowires with Quantum Dot as a Platform for experimentation in Quantum Technologies</b>	V 1.3	17:15	<b>Negative-tone dry development of PMMA for e-beam lithography</b>	V 2.4
	J Llobet, D Bricio, A Kapas, A Guerrero, J Sanchez, A Garcia, M Duch, X Borrísé, J Bausells, F Pérez-Murano Institute of Microelectronics of Barcelona (IMB-CNM CSIC), Bellaterra, 08193, Catalonia, Spain Catalan Institute of Nanoscience and Nanotechnology (ICN2), CSIC and BIST, Bellaterra, 08193, Catalonia, Spain			Furkan Ayhan, Thomas Mortelmans, Yasin Ekinci, Dimitrios Kazazis Paul Scherrer Institute, 5232 Villigen, Switzerland, Ecole Polytechnique Fédérale de Lausanne, 1015 Lausanne, Switzerland, Swiss Nanoscience Institute, University of Basel, 4056 Basel, Switzerland, Centre Suisse d'Électronique et de Microtechnique, 2002 Neuchâtel, Switzerland	
14:30	<b>Molecular Gates: Unlocking the Path to High-Resolution Patterning of Doping and Microstructure in Molecular Semiconductor Films</b>	V 1.4	17:15	<b>Direct Nanoimprint on Chalcogenide Glasses substrate for Optical Applications</b>	V 2.5
	Aleksandr Perevedentsev, Mariano Campoy-Quiles Institute of Materials Science of Barcelona (ICMAB-CSIC), 08193 Bellaterra, Spain			Sivan Tzadka(1,2), Natali Ostrovsky(1,2), Esti Toledo(1,2), G. Le Saux(1,2), Evyatar Kassis(3), Shay Joseph(3), and Mark Schwartzman(1,2) 1. Department of Materials Engineering, Ben-Gurion University of the Negev, Beer-Sheva, Israel 2. Ilse Katz Institute for Nanoscale Science and Technology, Ben-Gurion University of the Negev, Beer-Sheva, Israel 3. Optical Component Center, Rafael Advanced Defense Systems, Haifa, Israel	
14:45	<b>Q&amp;A</b>		17:15	<b>Integration by Focused Ion Beam of plasmonic nanostructures on Si-based device for UV light detection</b>	V 2.6
15:00	<b>INV Beyond Gallium: FIB based local materials property tuning with advanced ion sources</b>	V 1.5		E. Scattolo (a,b), A. Cian (a), D. Giubertoni (a), G. Paternoster (a), L. Petti (b), P. Lugli (b) (a) Sensors and Devices Center, Bruno Kessler Foundation, Trento, I-38123, Italy, (b) Free university of Bozen, 39100 Bolzano BZ, Italy	
	Gregor Hlawacek Institute for Ion Beam Physics and Materials Research Helmholtz—Zentrum Dresden—Rossendorf 01328 Dresden, Germany		17:15	<b>High aspect ratio fabrication by displacement Talbot lithography, silicon deep reactive ion etching and gold electroplating</b>	V 2.7
15:30	<b>INV Using a Liquid Metal Alloy Ion Source for FIB patterning of noble metal plasmonic nanostructures.</b>	V 1.6		Konstantins Jefimovs1, Zhitian Shi1,2, Lucia Roimano1,2,3, Craig Lawley1, Daniel Josell4, Vitaliy A. Guzenko1, Marco Stambanoni1,2 1 Photon Science Division, Paul Scherrer Institut, 5232 Villigen PSI, Switzerland 2 Institute for Biomedical Engineering, University and ETH Zürich, 8092 Zürich, Switzerland 3 Department of Physics and CNR-IMM- University of Catania, 64 via S. Sofia, Catania, Italy 4 Materials Science and Engineering Division, National Institute of Standards and Technology, Gaithersburg, Maryland 20899, USA	
	D. Giubertoni (a), A. Cian (a), E. Scattolo (a), R. Dell'Anna (a), G. Paternoster (a), J. Rodríguez-Alvarez (b,c), A. Guerrero (d), X. Borrísé (e), F. Perez-Murano (d) (a) Sensors and Devices Center, Bruno Kessler Foundation, Trento, I-38123, Italy, (b) Departament de Física de la Matèria Condensada, Universitat de Barcelona, 08028 Barcelona, Spain, (c) Institut de Nanociència i Nanotecnologia (IN2UB), 08028 Barcelona, Spain, (d) Instituto de Microelectrónica de Barcelona (IMB-CNM, CSIC), Bellaterra (Barcelona), 08193, Spain, (e) Institut Català de Nanociència i Nanotecnologia, Bellaterra (Barcelona), 08193, Spain		17:15	<b>Investigation of interfacial widths and line-edge roughnesses in microphase separated cylindrical block copolymer thin films</b>	V 2.8
16:00	<b>Fabrication of X-ray optical elements by two-photon polymerization 3D printing</b>	V 1.7		Julius Bürger, Hari Krishnan Venugopal, Daniel Kool, Teresa de los Arcos, Alejandro González Orive, Guido Grundmeier, Katharina Brassat, Jörg K.N. Lindner Nanostructuring, Nanoanalysis and Photonic Materials Group, Dept. of Physics, Paderborn University, Paderborn, Germany, Nanostructuring, Nanoanalysis and Photonic Materials Group, Dept. of Physics, Paderborn University, Paderborn, Germany, Technical and Macromolecular Chemistry, Dept. of Chemistry, Paderborn University, Paderborn, Germany, Institute of Materials and Nanotechnology, Universidad de La Laguna, Santa Cruz de Tenerife, Spain, Technical and Macromolecular Chemistry, Dept. of Chemistry, Paderborn University, Paderborn, Germany, Nanostructuring, Nanoanalysis and Photonic Materials Group, Dept. of Physics, Paderborn University, Paderborn, Germany, Nanostructuring, Nanoanalysis and Photonic Materials Group, Dept. of Physics, Paderborn University, Paderborn, Germany	
	Sanli, U. T.(1)*, ‡, Kubec, A. †(1,2), Qi, P.(1), Seiboth, F.(3), Vila-Comamala, J.(1) & David, C.(1) (1) Paul Scherrer Institute, Forschungsstrasse 111, 5232 Villigen PSI, Switzerland (2) XRnanotech GmbH, Forschungsstrasse 111, 5232 Villigen PSI, Switzerland (3) CXNS - Center for X-ray and Nano Science, Deutsches Elektronen-Synchrotron DESY, Notkestraße 85, 22607 Hamburg, Germany * Lead presenter. ‡ Project received funding from European Union's Horizon 2020 research and innovation pro-gramme under the Marie Skłodowska-Curie grant agreement No 884104 (PSI-FELLOW-III-3i) † Industry partner: <a href="https://www.xrnanotech.com/">https://www.xrnanotech.com/</a>		17:15	<b>EUV resist development with interference lithography</b>	V 2.9
16:15	<b>Latest results on radiation assisted nanomaterials synthesis and patterning using Deep X-ray lithography</b>	V 1.8		T. Allenet, M. Vockenhuber, C-K. Yeh, Y. Ekinci, D. Kazazis Laboratory for X-ray Nanoscience and Technologies, Paul Scherrer Institut, 5232 Villigen-PSI, Switzerland	
	B. Marmiroli (1), A. Turchet (2), B. Sartori (1), A. Bharti (2), H. Amenitsch (1) (1) Institute of Inorganic Chemistry, Graz University of Technology, Graz, Austria, (2) Elettra-Sincrotrone Trieste, Trieste, Italy		17:15	<b>Grayscale e-beam lithography for the fabrication of 3D microfluidic devices</b>	V 2.10
16:30	<b>Diamond optics for X-ray free-electron laser applications</b>	V 1.9		Thomas Mortelmans, Dimitrios Kazazis, Celestino Padeste, Xiaodan Li, Per Magnus Kristiansen, Yasin Ekinci Paul Scherrer Institute, 5232 Villigen-PSI, Switzerland, Swiss Nanoscience Institute, University of Basel, 4056 Basel, Switzerland, INKA Institute of Polymer Nanotechnology, FHNW, 5210 Windisch, Switzerland, University College Dublin, Belfield, Dublin 4, Ireland	
	Mamyrbayev, T.(1)*, Vila-Comamala, J.(1), Li, H.(2), Makita, M. (3), Zhu, D.(2) & David, C.(1) (1) Paul Scherrer Institut, 5232 Villigen PSI, Switzerland (2) Linac Coherent Light Source, SLAC National Accelerator Laboratory, Menlo Park, California 94025, USA (3) European XFEL GmbH, Holzkoppel 4, 22869 Schenefeld, Germany				
16:45	<b>Q&amp;A</b>				

17:15	<b>Single-digit nanometer EUV interference lithography</b> I. Giannopoulos, Y. Ekinci, D. Kazazis Laboratory for X-ray Nanoscience and Technologies, Paul Scherrer Institute, 5232 Villigen PSI, Switzerland	V 2.11
17:15	<b>Dopant patterning using monolayer doping and EUV interference lithography</b> Prajith Karadan, Dimitrios Kazazis, Yasin Ekinci Paul Scherrer Institute, 5232 Villigen PSI, Switzerland	V 2.12
17:15	<b>Fabrication of 1T-TaS<sub>2</sub> devices by electron beam lithography for investigation of non-equilibrium phase switching</b> C. Burri <sup>(1),(2)</sup> , J. Ravnik (1), D. Kazazis (1), D. Mihailovic (3), Y. Ekinci (1), S. Gerber (1) (1)Laboratory for X-ray Nanoscience and Technology, Paul Scherrer Institut, Villigen PSI, Switzerland (2)Laboratory for Solid State Physics, ETH Zurich, Zurich, Switzerland (3)Department of Complex Matter, Jožef Stefan Institute, Ljubljana, Slovenia	V 2.13
17:15	<b>Formulating a Dose Insufficiency Model for High-Resolution 50 kV Electron-Beam Lithography on Thick Resist Layers</b> Mattias Åstrand, Thomas Frisk, Hanna Ohlin, Ulrich Vogt KTH Royal Institute of Technology	V 2.14
17:15	<b>Metal Cupferrates as Novel High Resolution Molecular Resists for Electron Beam and Extreme Ultraviolet Lithographies</b> M. S. M. Saifullah, D. Kazazis, V. A. Guzenko, M. Vockenhuber, Y. Ekinci Paul Scherrer Institute, 5232 Villigen, Switzerland	V 2.15

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Presentation 2 : Francesz Perez Murano

09:00	<b>INV EUV lithography for more Moore</b> Yasin Ekinci Paul Scherrer Institut	V 3.1
09:30	<b>Al<sub>2</sub>O<sub>3</sub> dot and antidot arrays fabricated by SIS in hexagonally packed PS-b-PMMA BCP thin films</b> G. Seguini 1, A. Motta 1, M. Bigatti 1, F.E. Caligiore 1, G. Rademaker 2, A. Gharbi 2, R. Tiron 2, G. Tallarida 1, E. Cianci 1, and M. Perego 1 1 IMM-CNR, Unit of Agrate Brianza, Via C. Olivetti 2, I-20864 Agrate Brianza, Italy 2 Univ. Grenoble Alpes, CEA, Leti, F-38000 Grenoble, France	V 3.2
09:45	<b>Controlled, Rapid Synthesis of Microporous Polystyrene Thin Films</b> Philip Darragh, Dr. Ryan Enright, Prof. Michael Morris AMBER, CRANN Institute, Trinity College Dublin, Dublin 2, Ireland, Nokia Bell Labs, Murray Hill, New Jersey, USA	V 3.3
10:00	<b>INV Multi-Trigger Resist for EUV Lithography</b> C. Popescu(a), G. O'Callaghan(a), A. McClelland(a), J. Roth(b), E. Jacksonb, A.P.G. Robinson(a),(b) (a) Irresistible Materials, Birmingham Research Park, Birmingham, UK (b) Nano-C, 33 Southwest Park, Westwood, MA, USA. e-mail: a.p.g.robinson@bham.ac.uk	V 3.4
10:30	<b>NANOIMPRINT AS A LARGE-AREA NANOFABRICATION TECHNIQUE FOR DEVELOPING NOVEL ARCHITECTURES IN FLEXIBLE ULTRATHIN SOLAR CELLS</b> T.S. Lopes 1,2,3,4, J.P. Teixeira1, B.R. Ferreira1, M.A. Curado1,5, J.M.V. Cunha1,6,7, K. Oliveira1, A.J.N. Oliveira1,6,7,A.Violas1,6,7,8, J.R.S. Barbosa1, P.C. Sousa1, I.Çaha1 J. Borme1, J. Ring9, W.C. Chen8, Y. Zhou9, F.L. Deepak1 ,M. Edoff8, G. Brammertz2,3,4, P.A. Fernandes1,7,10, B. Vermang2,3,4, P.M.P. Salomé1,6 1-INL – International Iberian Nanotechnology Laboratory, Avenida Mestre José Veiga, 4715-330 Braga, Portugal 2-Institute for Material Research (IMO), Hasselt University (partner in Solliance), Agoralaanbouw H, Diepenbeek, 3590, Belgium 3-Imec division IMOMEC (partner in Solliance), Wetenschapspark 1, 3590 Diepenbeek, Belgium 4-EnergyVille, ThorPark, Poort Genk, 8310 & 8320, 3600 Genk, Belgium 5- CFisUC, Department of Physics, University of Coimbra, P-3004-516 Coimbra, Portugal 6-Departamento de Física, Universidade de Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal 7-i3N, Universidade de Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal 9- Ångström Laboratory, Department of Engineering Sciences, Uppsala University, 751 21 9 -Obducat AB, Medicon Village, 223 63 Lund Sweden Uppsala, Sweden 10-CIETI, Departamento de Física, Instituto Superior de Engenharia do Porto, Instituto Politécnico do Porto, 4200-072, Porto Portugal	V 3.5
10:45	<b>Q&amp;A</b>	
11:00		
11:15	<b>INV Bio-inspired directed self assembly as patterning solution: when Topdown meets bottom-up</b> Raluca Tiron Univ. Grenoble Alpes, CEA, LETI	V 3.6
11:45	<b>Soft nanoimprint lithography of silica sol gel for microelectronic and biological applications</b> David Sánchez-Fuentes* (1), R.Rathar (2), L. Picas (2), A. Carretero-Genevriér. (1) (1) Institut d'Electronique et des Systemes (IES), CNRS, Université de Montpellier, 860 Rue de Saint Priest 34095 Montpellier, France (2) Institut de Recherche en Infectiologie de Montpellier (IRIM), CNRS, 1919 Route de Mende, 34090 Montpellier, France * lead presenter	V 3.7
12:00	<b>Laser 3D nanolithography for sub-100 nm additive manufacturing of inorganics</b> Greta Merkininkaitė, Darius Gailevičius, Simas Sakirzanovas, Mangirdas Malinauskas 1. Faculty of Chemistry and Geosciences, Vilnius University, Naugarduko Str. 24, Vilnius LT-03225, Lithuania 2. Femtika, Sauletekio Ave. 15, Vilnius LT-10224, Lithuania 3. Laser Research Center, Physics Faculty, Vilnius University, Sauletekio Ave. 10, Vilnius LT-10223, Lithuania 4. Department of Chemical Engineering and Technology, Center for Physical Sciences and Technology, Sauletekio Ave. 3, Vilnius LT-10257, Lithuania	V 3.8

- 12:15**      **Bringing electrochemical 3D printing to the nanoscale**  
Dmitry Momotenko  
Department of Chemistry, Carl von Ossietzky University of Oldenburg, Oldenburg,  
D-26129, Germany
- 12:30**      **Q&A and closing remarks**

**V 3.9**