EIPBN

LA JOLLA : TORREY PINES : 2024

Program

The 67th International Conference on Electron, Ion, and Photon Beam Technology and Nanofabrication

Hilton La Jolla Torrey Pines

A Letter from the EIPBN 2024 Conference Chair

Friday May 24, 2024

Aimee Bross Price

Dear EIPBN Community:

Welcome to the 67th International Conference on Electron, Ion, Photon Beam Technology and Nanofabrication (EIPBN). San Diego has been a popular location for EIPBN and La Jolla Torrey Pines continues the trend. We have 400 attendees from 19 countries, including 148 first time attendees, and over 90 students. The Hilton La Jolla Torrey Pines was scheduled to host EIPBN in 2021 before the conference was forced to go virtual and we are grateful for the opportunity hold the conference here in 2024.

I first attended EIPBN in 2002 in Anaheim as a young EBL engineer at TriQuint Semiconductor (now Qorvo), too intimidated to leave the hotel except for the banquet, spending all breaks in my room. Thankfully, I quickly learned that 3-Beams is a welcoming, supportive community of researchers and industry professionals. Learning about cutting edge research, new equipment technology, and mentorship by long time 3-Beamers was critical to my remaining in the field. Serving the same community as Conference Chair is an honor and privilege that I do not take lightly, and I am humbled to be the first woman to serve in this role.

The dynamic interactions between attendees, exhibitors, and sponsors help define the community of EIPBN that makes this conference special. Relationships established in exhibit halls and networking events continue for years and even decades. Thank you to our Platinum Sponsor Heidelberg Instruments; Gold Sponsor STS-Elionix; Silver Sponsors AllResist, GenISys, JEOL, and Raith; and all our exhibitors and sponsors: Beamfox, Cleanroom Labware, Cornell NanoScale Science and Technology Facility, Crestec, Dischem EVG, Herzan, Heteromerge, Ionoptika, Jenoptik, KLA, Lab14, MAEBL, Microlightt 3D, Nanoscribe, Nuflare, Oregon Physics, Prinano, Quantum Design, SAES, Secure Foundry, TEL, Tescan, Tetramem, Tousimis, Valutek, Vanguard Automation, Vistec Electron Beam, XRNanotech, Zeiss, Zeon, and Zyvex Labs. I also thank our government and society sponsors: DOE, AVS, and IEEE Nano. New this year is an opportunity for academic nanofabs to sponsor students and highlight their facilities; thank you to University of Pennsylvania Singh Center for Nanotechnology, The Ohio State Institute for Materials & Manufacturing Research, University of Colorado Boulder Colorado Shared Instrumentation in Nanofabrication and Characterization (COSINC), Georgia Tech Institute for Matter and Systems, Montana Tech, NFCF Nano Pittsburgh, Texas A&M AggieFab, and Princeton Materials Institute at Princeton University. *Note that contributions to and/or sponsorship of any event does not constitute departmental or institutional endorsement of the specific program, speakers, or views presented.*

Program Chair Wei Wu has developed an incredible program with 30 sessions over a broad range of topics. The program will be kicked off by true giants in our field: Professor John Rogers (Northwestern University), Professor Paul Weiss (UCLA), and Dr. Carlos Diaz (TSMC). They will set the tone for the conference, and I am thrilled that my undergraduate research advisor, Paul Weiss, agreed to share his work here more than 20 years after instilling in me a love for surface science. Thank you, Wei, for your thoughtfully designed program and positive spirit in creating it.

EIPBN is a run by a dedicated group of volunteer steering committee members working year-round to ensure a successful conference. I am grateful for the dedication by the 2024 steering committee: Qiangfei Xia, Chih-Hao Chang, Gerald Lopez (Student Lunch & Interim Ops Trustee), Martha Sanchez (WIN), James Owen (Commercial Session), Rick Silver (Startup Contest), Jack Skinner, and Rajesh Menon (Short Course). Thank you to our behind-the-scenes team working tirelessly on our behalf: Financial Trustee John Randall; Corporate Accountant Denise Hayner; Attorney Lynne Schoenling; Conference Coordinator Jonni Adams; Nichole Ballard and Yes Events (Registrar); Photographer Mike Huson; and Nicki Davis who manages our website and Guidebook App. I appreciate the efforts of the program committee, abstract reviewers, and volunteers including Gina Adam, Regina Luttge, Emine Cagin (WIN); Vishva Ray, and Guy DeRose (Commercial Session). Thank you also to the Advisory Committee for their continued service to the conference and community. Finally thank you to all members of the EIPBN Community for joining us in beautiful La Jolla Torrey Pines.

A Letter from the EIPBN 2024 Program Chair

Wednesday, May 15, 2024

Dear EIPBN Community:

I am thrilled to welcome each one of you to EIPBN 2024. Having attended every EIPBN since 1998, when I first joined as a graduate student, I truly believe that the EIPBN community has become like family to me. It is with great honor that I now serve as your Program Chair, and I am eager to make this conference both enjoyable and memorable for all. Let us look forward to an engaging and fruitful gathering as we continue to advance our field together.

As we convene for EIPBN 2024, it's worth reflecting on the extraordinary times we are living through—arguably the most exciting in human history. Technological progress is accelerating at an unprecedented pace, transforming lives in ways our ancestors could never have imagined. Today, we can video call someone on the other side of the globe with ease, and cars with the power of hundreds of horses can nearly drive themselves. For more than fifty years, we have reaped the benefits of "Moore's Law." Although we may be approaching the end of "Moore's Law," it signifies not an end but the beginning of a new era. We are poised to use nanofabrication technologies and knowledge to make an even greater and broader impact on society. Looking forward, future generations may well see our current time as the starting point of this transformative era.

In addition to our rich technical program, EIPBN 2024 will feature several special events that reflect both current trends and our community's interests. This year, we cannot overlook the impact of artificial intelligence, which is reshaping daily life and presenting both opportunities and challenges to the nanofabrication and nanomanufacturing sectors. To address this, we have organized a panel discussion on "Nanomanufacturing in the AI Era." Other highlights include the Commercial Lightning Talks, the Women in Nanotechnology (WIN) Luncheon, the Conference Banquet, and the Student Mentor Lunch. These events are designed to foster networking, collaboration, and inspiration among all attendees.

I would like to express my deep appreciation to everyone who has played a pivotal role in bringing EIPBN 2024 to fruition. Special thanks to our Conference Chair, Ms. Aimee Price, whose relentless dedication and hard work have been instrumental in organizing this event. Aimee has truly done all the heavy lifting, and I am immensely grateful for her support and guidance, as well as for her patience in correcting my mistakes along the way. Furthermore, my heartfelt thanks go to the steering committee, advisory committee, session chairs, paper reviewers, panelists, plenary and invited speakers, all authors, and, of course, all our attendees. Your collective efforts enrich our conference and strengthen our community, ensuring that EIPBN remains a premier event in our field.

Sincerely,

Wei Wu, EIPBN 2024 Program Chair

Professor, the Ming Hsieh Department of Electrical and Computer Engineering

University of Southern California

About EIPBN 2024

The International Conference on Electron, Ion, and Photon Beam Technology and Nanofabrication (EIPBN), affectionately known as “3–beams,” is the premier gathering of scientists and engineers who are dedicated to electron, ion and photon lithography, imaging, and analysis; atomically precise fabrication; nanofabrication process technologies; related emerging technologies; and their applications in a broad spectrum of fields. This is the 67th meeting of the EIPBN, where top researchers from academia, government laboratories, and industry from around the world meet to present and discuss recent trends and future directions in these technologies.

EIPBN is incorporated as a nonprofit organization in the state of New Jersey. The ten member Steering Committee serves as the corporate Board of Directors. Each year, two distinguished members from the EIPBN community are elected to serve a five-year term. New members participate in the organization of the conference for the first two years. In the third year, they run the meeting as either the Conference or Program Chair. In the final two years, they assist the successor chairs in their duties. Upon completion of their five-year term, Steering Committee members become permanent members of the Advisory Committee.

The 2024 Steering Committee Members are Aimee Bross Price, Wei Wu, Gerald Lopez, Martha Sanchez, James Owen, Richard Silver, Qiangfei Xia, Chih-Hao Chang, Jack Skinner, and Rajesh Menon.

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EIPBN is sponsored by two distinguished societies: the American Vacuum Society and the IEEE NANO.

The special events at this year’s conference are highlighted below.

Short Courses
(Tue, May 28 8:30 am - 2:30 pm)

This event features four lectures given serially by leading authorities in their field of expertise and is a perfect opportunity to further your knowledge of nanofabrication processes and applications.

Startup Session and Contest
(Tue, May 28, 2:30 pm - 3:30 pm)

The EIPBN 2024 Startup Contest is designed to support entrepreneurs, students, research staff, and faculty transition early-stage technologies from the lab into scalable ventures. Entry is open to startups at any stage of development.

Welcome Reception
(Tue, May 28, 7:00 pm - 8:30 pm)

The Welcome Reception will feature small hot bites and drink, and an opportunity to relax, mingle, get reacquainted with colleagues and make new friends. The reception is located in the Parterre Gardens and Terrace.

Women in Nanofabrication Luncheon
(Thu, May 30, 12:10 pm - 1:40 pm)

Women in Nanofabrication (WIN) is a networking event that brings together women in science and engineering from around the world. This luncheon enhances the fields of lithography and nanotechnology through diversity and inclusion.

Panel Discussion
"Nanomanufacturing in the AI Era."
(Thu, May 30, 4:30 pm - 6:00 pm)

The panel will address how artificial intelligence is reshaping daily life and presenting both opportunities and challenges to the nanofabrication and nanomanufacturing sectors. The panel is a conference-wide event organized to enable an open forum to discuss this new era. The session will be led by a moderator and panelists from industry, government research laboratory, and academia.

EIPBN Banquet
(Thu, May 30, 7:00 pm - 10:00 pm)

The 2024 Banquet will be on Thursday, May 30, in the Parterre Gardens, Terrace, and Foyer. The banquet will feature views of the Torrey Pines Golf Course, Pacific Ocean, and talents of Johnny and Farah, a San Diego duo that have a pure and sincere voice and a set list that will cover well-known classics to contemporary/top 40 selections.

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Student Mentor Lunch
(Fri, May 31, 12:00 pm - 1:30 pm)

The Student Mentor Lunch gives students a chance to hear from professionals in academia, government labs and industries. They can learn beneficial information that will help guide them as they grow in their fields. It's a chance to hear from the experts why they chose their field, what it takes to get there, and what it's really like once they arrived. The Student Mentor Lunch also features a speaker who provides an expert "how to" discussion on a new topic each year. RSVP required to ensure enough meals.

Micrograph Contest

EIPBN holds an annual micrograph contest to highlight the importance of micrographs. Micrographs need not be related to research or to any paper or topic presented at the conference. Submissions may be purely for their beauty and ability to excite curiosity.

The EIPBN Best Student Paper Awards

This annual competition highlights outstanding student contributions and fosters the next generation of leaders in the EIPBN community. The competition includes two categories: The Best Student Poster Award and The Best Student Presentation Award.

Generous Support for this Conference is Provided By

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Supported by PMI, Princeton University*

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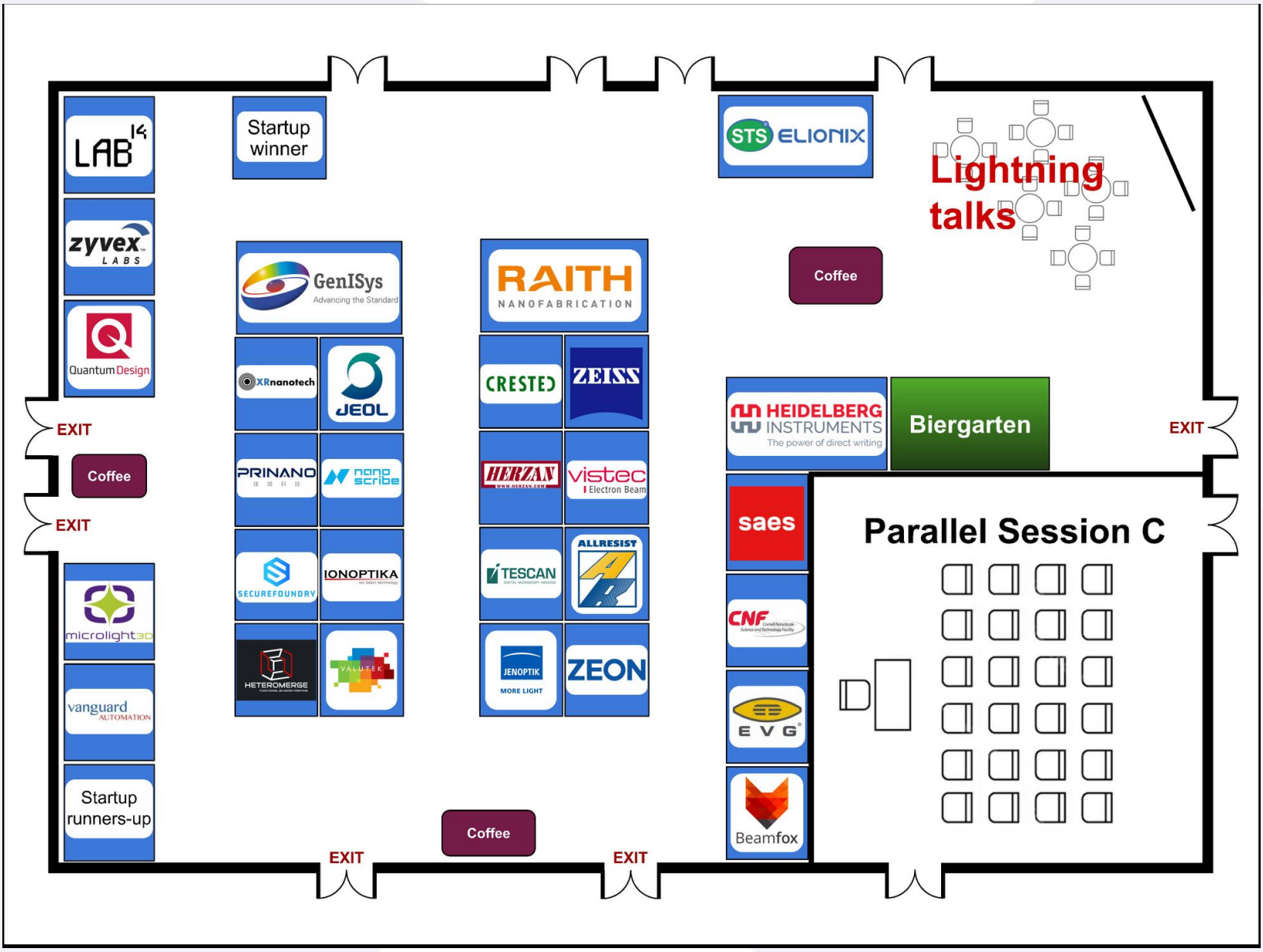
2024 Exhibitors



AT A GLANCE

EIPBN
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Tuesday, May 28, 2024

Time	Session	Location
7:00 am–6:00 pm	Registration	Hotel Level 1- Base of Escalator
9:00 am–3:00 pm	GenISys User Meeting – Invitees by GenIsys only	Fairway I/IV
8:30 am–2:30 pm	Short Course Sessions	Fairway II/III
10:40–11:00 am	Coffee Break - Sponsored by Crestec	Fairway Foyer East
12:00–1:25 pm	Short Course Lunch	Fairway Gardens
2:30–3:30 pm	Start-Up Session and Contest	Fairway II/III
4:00–7:00 pm	Commercial Exhibit	Grande Ballroom A,B,C,D
7:00–8:30 pm	Welcome Reception - Light Bite Hors D'Oeuvres Sponsored by AllResist	Grande Ballroom Foyer and Parterre Terrace/Garden

Wednesday, May 29, 2024

Time	Session	Location
6:45–7:30 am	Session Chair Breakfast	Scripps 1
7:00 am–5:00 pm	Registration	Hotel Level 1- Base of Escalator
7:30–8:00 am	Coffee And Tea - Sponsored by Nuflare/GenISys	Fairway Foyer
8:00–10:45 am	Plenary Session	Fairway Ballroom
10:45–11:30 am	Coffee Break	Grande Ballroom and Grande Prefunction
10:00 am–5:00 pm	Commercial Exhibit	Grande Ballroom A,B,C,D
10:45 am–1:00 pm	Poster Session	Grande Ballroom Foyer
11:15 am–12:15 pm	Commercial Session "Lightning Talks"	Grande Ballroom C
12:00–1:10 pm	Advisory Committee Lunch Meeting – by invitation only	Ocean
1:20–3:10 pm	Workshop on Emerging Memory Infrastructure	Fairway Ballroom
	Session 1A - Advanced micro/nanolithography 1	Scripps I
	Session 1B - Directed self-assembly	Scripps II
	Session 1C - Nanofabrication for quantum computing	Grande E
3:10–3:30 pm	Coffee break - Sponsored by AllResist	Grande Ballroom and Grande Prefunction
3:30–5:20 pm	Workshop on Emerging Memory Infrastructure	Fairway Ballroom
	Session 2A - Atomically precise fabrication	Scripps I
	Session 2B - Metamaterials, metasurfaces, & meta-optics 1	Scripps II
	Session 2C - Micro/nanoelectromechanical systems (MEMS/NEMS) and Micro/Nanofluidics	Grande E
5:45–7:00 pm	Poster Session Reception - Sponsored by STS-Elionix/Allresist	Grande Ballroom Foyer

Thursday, May 30, 2024

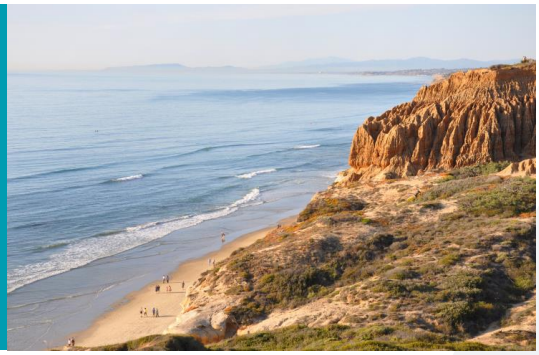
Time	Session	Location
7:00 am–5:00 pm	Registration	Hotel Level 1 - Base of Escalator
7:00–8:00 am	Coffee And Tea - Sponsored by SAES/AllResist	Scripps Hallway
8:00–9:50 am	Session 3A - Electron and ion beam lithography	Scripps I
	Session 3B - Nanophotonics and plasmonics 1	Scripps II
	Session 3C - Industrial Highlights	Grande E
9:50–10:20 am	Coffee Break - Sponsored by GenISys/Vistec	Scripps Hallway
10:00 am–1:00 pm	Commercial Exhibit	Grande Ballroom A,B,C,D
10:00 am–1:00 pm	Posters Available for Viewing	Grande Ballroom Foyer
10:20 am–12:10 pm	Session 4A - Optical/EUV lithography and metrology	Scripps I
	Session 4B - Ion beam 1	Scripps II
	Session 4C - Workforce Development - Chair's Special Session	Grande E
12:10–1:30 pm	Women in Nanofabrication (WIN) Luncheon – sign up required Sponsored by STS-Elionix/Zeiss/Raith/Heidelberg/Allresist	Fairway Ballroom
1:40–3:30 pm	Session 5A - Nanoimprint lithography & scalable manufacturing	Scripps I
	Session 5B - Ion beam 2	Scripps II
	Session 5C - Nanoelectronics	Grande E
3:30–4:30 pm	Break	
4:30–6:00 pm	Panel Discussion - Nanomanufacturing in the AI era	Fairway Ballroom
6:00–7:00 pm	Thank you toast for exhibitors - by invitation	Torreyana
7:00–10:00 pm	Banquet - Sponsored by LAB14/Heidelberg	Parterre Gardens, Terrace, and Foyer

Friday, May 31, 2024

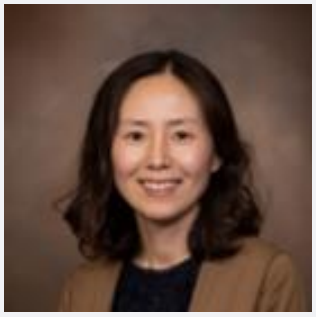
7:00 am–12:00 pm	Registration	Hotel Level 1 - Base of Escalator
7:00–8:00 am	Coffee And Tea I Sponsored by Cleanroom Labware	Scripps Hallway
8:00–9:50 am	Session 6A - Advanced micro/nanolithography 2	Scripps I
	Session 6B - Ion beam 3	Scripps II
	Session 6C - Applications of nanofabrication 1	Grande E
9:50–10:20 am	Coffee Break - Sponsored by TetraMem/GenISys	Scripps Hallway
10:20 am–12:00 pm	Session 7A - Scalable micro/nanomanufacturing 1	Scripps I
	Session 7B - Metamaterials, metasurfaces, and meta-optics 2	Scripps II
	Session 7C - Personalized healthcare and nanofluidics	Grande E
12:00–1:30 pm	Student Mentor Lunch (RSVP required) - Sponsored by KLA	Grande Ballroom C
12:00–1:30 pm	GenISys Metrology Luncheon - see GenISys Representative	Grande Ballroom D
1:30–3:20 pm	Session 8A - Scalable micro/nanomanufacturing 2	Scripps I
	Session 8B - Simulation, modeling, and design tools for nanofabrication	Scripps II
	Session 8C - Nanobiology, nanomedicine, & implantable devices	Grande E
3:20–3:40 pm	Break - Ice Cream - Sponsored by GenISys	
3:40–5:30 pm	Session 9A - Resists and materials	Scripps I
	Session 9B - Nanophotonics and plasmonics 2	Scripps II
	Session 9C - Applications of nanofabrication 2	Grande E

Short Courses

Tuesday May 28, 2024, from 8:30 am to 2:30 pm



The popular EIPBN Short Courses takes place on Tuesday, May 28, 2024, 8:30 am to 2:30 pm. This event features four lectures given serially by leading authorities in their field of expertise and is a perfect opportunity to further your knowledge of nanofabrication processes and applications. This year's Tuesday Short Courses are:



Nanoscale Characterization of Emerging Photovoltaic Materials and Devices
Heayoung Yoon, University of Utah
Prof. Yoon is an Associate professor of ECE at the University of Utah. Her research focuses on nanofabrication and characterizations of solar energy materials and devices.

Processing of Gallium Oxide Power Semiconductor Materials and Devices
Sriram Krishnamoorthy, University of California, Santa Barbara
Prof, Krishnamoorthy is Associate Professor in the Materials Department at University of California, Santa Barbara, working at the intersection of materials, electrical engineering, and physics to study and engineer wide and (ultra)wide band gap semiconductors such as Gallium Oxide.

Symmetry and Topology in Photonic Nanostructures for Sensing and Imaging Applications
Abdoulaye Ndao, University of California, San Diego
Prof. Ndao is an Assistant Professor of Electrical and Computer Engineering. Before Joining UC San Diego, Abdoulaye Ndao was assistant professor at Boston University from 2020 to 2023. His research interests span wide-ranging topics in photonics, material sciences, and physics.

Patents & Intellectual Property 101
Franklin Schellenberg, Haynes Beffel and Wolfeld
Dr. Schellenberg has a Ph.D. in Applied Physics from Stanford University for work on nonlinear optical materials at both Stanford and the University of Tokyo. He has been Conference Chair for EIPBN (2010) and for various SPIE Conferences and Workshops. He is an inventor on over 33 issued patents, and a contributing author to several books and over 70 technical publications.

Startup Contest

Tuesday May 28, 2024, from 2:30 pm to 3:30 pm

Dr. Florian Döring, XRnanotech

The EIPBN 2023 Startup Session and Contest is designed to support entrepreneurs, students, and research staff to help facilitate transition of early-stage technologies into scalable ventures. The contest encourages participation from all ventures incorporating new technical findings from any of EIPBN's fields of scientific interest. Entry is open to startups at any stage of development: from early ideation (pre-seed) to technology validation and growth. This contest aims to support the transition of technology and ideas from the lab into a scalable venture.

This year's participating startups will pitch their innovations live to a distinguished panel of judges and the conference audience immediately following Tuesday's Short Courses.

The winning startup will be announced at the EIPBN Banquet on Thursday. The Startup Contest winner will receive a sponsored exhibitor package.

The Startup Session is kicked off with a Keynote address by Dr. Florian Döring titled:

From Science to Startup – The Story of XRnanotech

Dr. Florian Döring is the CEO and founder of XRnanotech, an award winning Swiss deep-tech company that develops and fabricates innovative diffractive optical elements. He holds a PhD in Materials Physics from the University of Göttingen and was a postdoctoral fellow in the lab for micro- and nanotechnology of the Paul Scherrer Institut in Switzerland. During his research career, he developed and fabricated high-quality X-ray optics with record-breaking resolution. Following his entrepreneurial mindset, he completed an MBA and thereafter founded the company XRnanotech with the vision of bringing these record-breaking optics to the market. With his dedicated team of scientists, engineers and business people, he is constantly working to develop even better nanostructures and optics and making them available to customers all over the world.

Plenary Session

Fairway Ballroom

Wednesday May 29, 2024, from 8:00 am to 10:45 am

The Plenary Session begins on Wednesday, May 31, 2023, at 8:00 am with opening remarks by the Conference and Program Chairs. This is followed by three Plenary Talks by leading visionaries.

Welcome, Opening Remarks, and Announcements

Aimee Bross Price (Ohio State), Conference Chair & Wei Wu (USC), Program Chair

Micro/nanofabrication Techniques for 3D Functional Mesosystems: From Neural Interfaces to Environmental Monitors

John A. Rogers, Northwestern University

Understanding and Controlling Charge, Heat, and Spin at Atomically Precise Interfaces

P. S. Weiss, UCLA

Trends and future directions in logic technologies: research challenges and opportunities

Carlos H. Díaz, Taiwan Semiconductor Manufacturing Company

Plenary Session 1 – Fairway Ballroom

Wednesday May 29, 2024, from 8:30 am to 9:15 am

Micro/nanofabrication Techniques for 3D Functional Mesosystems: From Neural Interfaces to Environmental Monitors

John A. Rogers, Louis Simpson and Kimberly Querrey Professor of Materials Science and Engineering, Biomedical Engineering and Neurological Surgery, Northwestern University

Complex, three-dimensional (3D) micro/nanostructures in biology provide sophisticated, essential functions in even the most basic forms of life. Compelling opportunities exist for analogous 3D structures in man-made devices, but existing design options are highly constrained by comparatively primitive capabilities in fabrication and growth. Recent advances in mechanical engineering and materials science provide broad access to diverse, highly engineered classes of 3D architectures, with characteristic dimensions that range from nanometers to centimeters and areas that span square centimeters or more. The approach relies on geometric transformation of preformed two-dimensional (2D) precursor micro/nanostructures and/or devices into extended 3D layouts by controlled processes of substrate-induced compressive buckling, where the bonding configurations, thickness distributions and other parameters control the final configurations. This talk reviews the key concepts and focuses on the most recent developments with example applications in areas ranging from mesoscale microfluidic/electronic networks as neural interfaces, to bio-inspired microfliers as environmental sensing platforms.

Professor John A. Rogers began his career at Bell Laboratories as a Member of Technical Staff in the Condensed Matter Physics Research Department in 1997, and served as Director from the end of 2000 to 2002. He then spent thirteen years at the University of Illinois, as the Swanlund Chair Professor and Director of the Seitz Materials Research Laboratory. In 2016, he joined Northwestern University as the Simpson/Querrey Professor, where he is also Director of the Institute for Bioelectronics. He has co-authored nearly 900 papers and he is co-inventor on more than 100 patents. His research has been recognized by many awards, including a MacArthur Fellowship (2009), the Lemelson-MIT Prize (2011), the Smithsonian Award for American Ingenuity in the Physical Sciences (2013), the Benjamin Franklin Medal (2019), and a Guggenheim Fellowship (2021). He is a member of the National Academy of Engineering, the National Academy of Sciences, the National Academy of Medicine and the American Academy of Arts and Sciences.

Plenary Session 2 – Fairway Ballroom

Wednesday May 29, 2024, from 9:15 am to 10:00 am

Understanding and Controlling Charge, Heat, and Spin at Atomically Precise Interfaces

Paul S. Weiss, UC Presidential Chair, Distinguished Professor of Chemistry & Biochemistry, Bioengineering, Distinguished Professor of Materials Science & Engineering, UCLA

One of the key advances in nanoscience and nanotechnology has been our increasing ability to reach the limits of atomically precise structures. By having developed the "eyes" to see, to record spectra, and to measure function at the nanoscale, we have been able to fabricate structures with precision as well as to understand the important and intrinsic heterogeneity of function found in these assemblies. The physical, electronic, mechanical, thermal, and chemical connections that materials make to one another and to the outside world are critical. Just as the properties and applications of conventional semiconductor devices depend on these contacts, so do nanomaterials, many nanoscale measurements, and devices of the future. We explore the important roles that these contacts can play in preserving key transport and other properties. Initial nanoscale connections and measurements guide the path to future opportunities and challenges ahead. Band alignment, minimally disruptive connections, and control of spin and heat are all targets and can be characterized in both experiment and theory. I discuss our initial forays into this area in a number of materials systems.

Paul S. Weiss graduated from MIT with S.B. and S.M. degrees in chemistry and from the University of California at Berkeley with a Ph.D. in chemistry. He is a nanoscientist and holds a UC Presidential Chair and is a distinguished professor of chemistry & biochemistry, bioengineering, and materials science & engineering at UCLA, where he was previously director of the California NanoSystems Institute. He currently holds visiting appointments at Harvard's Wyss Institute and several universities in Australia, China, Hong Kong, India, and South Korea. He studies the ultimate limits of miniaturization, developing and applying new tools and methods for atomic-resolution and spectroscopic imaging and patterning of chemical functionality. He and his group apply these advances in other areas including neuroscience, microbiome studies, tissue engineering, cellular agriculture, and high-throughput gene editing. He led, coauthored, and published the technology roadmaps for the BRAIN Initiative and the U.S. Microbiome Initiative. He was the founding editor-in-chief of *ACS Nano* and served in that role from 2007–2021. He has won a number of awards in science, engineering, teaching, publishing, and communications. He is a fellow of the American Academy of Arts and Sciences, American Association for the Advancement of Science, American Chemical Society, American Institute for Medical and Biological Engineering, American Physical Society, American Vacuum Society, Canadian Academy of Engineering, IEEE, Materials Research Society, National Academy of Inventors, and an honorary fellow of the Chinese Chemical Society and Chemical Research Society of India.

Plenary Session 3 – Fairway Ballroom

Wednesday May 29, 2024, from 10:00 am to 10:45 am

Trends and Future Directions in Logic Technologies: Research Challenges and Opportunities

Carlos H. Diaz, Senior Director

Sustainable growth in computing performance supporting expanded functional capabilities of information technology and communication products requires energy-efficiency improvements of underlying technologies from devices and interconnect fabrics, system architectures, to algorithms and software, and innovations on information representation and its associated processing. Bridging the gap between existing silicon nanotechnology platforms and evolving system integration with expanded functionalities necessitates disruptive innovations t materials and processes level enabling novel devices and interconnect fabrics, each and all cohesively facilitating higher integration-density, performance, and energy efficiency that are scalable. Research and development monumental efforts on silicon-based CMOS technology scaling continuously raise the bar on energy-efficiency, performance, density, reliability, and cost that exploratory devices, interconnects, and novel integration concepts ought to meet to be of impactful technological value. This talk will overview emerging transistors, memories, interconnect fabrics, their integration, material; aiming to draw attention into the research challenges and opportunities so to identify viable alternative technology essential constituents beyond those of the projected evolutionary paths of current state-of-the art logic technologies.

Carlos H. Diaz holds a Ph.D. in EE from University of Illinois at Urbana-Champaign. He is Senior Director in Research and Development, Taiwan Semiconductor Manufacturing Company. He has published over 100 technical papers, holds over 225 US patents, and has published one book. Dr. Diaz was elected an IEEE Fellow in 2008 for his contributions to deep-submicron foundry technology. In 2011, he was co-recipient of the Annual Innovation Breakthrough Award, Ministry of Economic Affairs, Taiwan R.O.C., conferred to TSMC's 28nm logic technology. He was the recipient of the 2016 IEEE Andrew Grove Award for sustained contributions to and leadership in foundry advanced CMOS logic transistor technology. He received the Distinguished Alumni Award in Electrical and Computer Engineering, University of Illinois at Urbana-Champaign in 2018.

Women in Nanofabrication

Thursday May 30, 2024, from 12:10 pm to 1:30 pm

Women in Nanofabrication (WIN) is a networking event that brings together women in science and engineering from around the world. This luncheon enhances the fields of lithography and nanotechnology through diversity and inclusion. There is no charge to participate in this event, but RSVP strongly encouraged.

This year WIN is honoring Professor Rebecca Cheung for her long-term contributions to EIPBN from technical advancement to conference leadership and mentorship.

For more information about the WIN community. Please join the EIPBN Women in Nanofabrication Group.

Rebecca Cheung
University of Edinburgh, Scotland, UK

The WIN Luncheon is generously sponsored by Allresist, Heidelberg Instruments, Raith, STS – Elionix, and Zeiss.

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WIN Monthly Meetings

The **WIN** meetings were launched virtually through EIPBN Gather Town during EIPBN 2021 and are ongoing, but currently held over Zoom. **WIN** welcomes volunteers to share your career experiences and insights or present a technical talk about your research. Please contact Martha Sanchez at martha.i.sanchez05@gmail.com for questions or to enroll and include WIN@EIPBN-Gather/Volunteer in the subject line.

Panel Discussion Session: Nanomanufacturing in the AI era.

Thursday, May 30, 202, from 4:30 pm to 6:00 pm

EIPBN
LA JOLLA : TORREY PINES : 2024

EIPBN 2024 will have a special Panel Discussion Session on **"Nanomanufacturing in the AI era"** on Thursday, May 30, 2024, 4:30 pm - 6:00 pm. The goal of the conference-wide event is to have an open discussion on both the opportunities and challenges of nanomanufacturing technology in the AI era and how our community should prepare for it. The moderator and panelists include representatives from government, industry, and academia:

Moderator

Gina Adam, George Washington University

Gina Adam is an assistant professor with the Electrical and Computer Engineering department at George Washington University. Her group works on the development of emerging non-volatile memory devices and novel hardware foundations that will enable new ways of neuro-inspired computing.

Panelists

Khershed P. Cooper , National Science Foundation

Khershed P. Cooper is a Program Director for Advanced Manufacturing in the Civil, Mechanical and Manufacturing Innovation (CMMI) Division of the Engineering (ENG) Directorate NSF. Dr. He directs key research in advanced and nano manufacturing at NSF, serving as a program officer for various national and international collaborations, and holds an extensive background in materials science with numerous publications, presentations, and a distinguished history of service in both industrial and academic settings.

Alvin Loke, INTEL

Alvin Loke is a Senior Principal Engineer at Intel Corporation working on analog methodologies and design/technology co-optimization for Intel's most advanced process technologies. He received his Ph.D. from Stanford and has previously worked on CMOS nodes from 250nm to 2nm with experience spanning process integration to analog/mixed-signal and wireline design to design/model/technology interfacing.

Patrick Jungwirth , Army Research Lab

Patrick Jungwirth is a research computer engineer at the Army Research Lab. He received his PhD in electrical engineering from University of Alabama in Huntsville. His areas of interest cover computer architectures and analog-to-digital conversion.

Niels Wijnaendts van Resandt, LAB14

Niels Wijnaendts van Resandt received his masters degree in physics from the university of Heidelberg in 1995 and has since spent most of his career in various roles at Heidelberg Instruments for which he founded the US office 25 years ago. Since 2022 his role is "Head of Business Development" at LAB14, which is a holding that besides Heidelberg Instruments owns a number of companies active in micro- and nanofabrication and surface analytics and metrology.

Qiangfei Xia, University of Massachusetts Amherst

Qiangfei Xia is an Electrical & Computer Engineering Professor at the University of Massachusetts Amherst and the Head of the Nanodevices and Integrated Systems Lab. His research interest lies primarily in emerging semiconductor devices and integrated systems for applications in machine intelligence, reconfigurable radiofrequency systems, hardware security, etc.

Student Mentor Lunch

Friday, May 31, 2024 12:00 pm – 1:30 pm

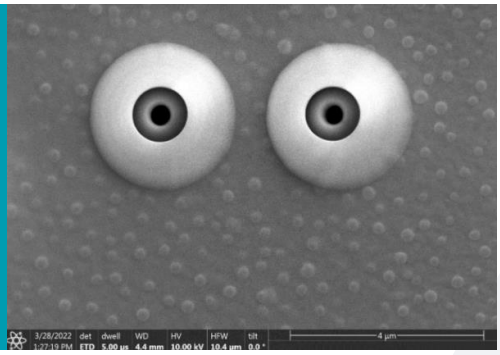
The Student Mentor Lunch gives students a chance to hear from professionals in academia, government labs and industries. They can learn beneficial information that will help guide them as they grow in their fields. It's a chance to hear from the experts on why they chose their field, what it takes to get there, and what it's really like once they have arrived. The Student Mentor Lunch also features a speaker who provides an expert "how to" discussion on a new topic each year.

Prof. Stella W. Pang

Prof. Stella W. Pang is a Chair Professor in the Department of Electrical Engineering and the Director of the Center for Biosystems, Neuroscience, and Nanotechnology at the City University of Hong Kong, China. Prior to her current roles, she was a Professor and Associate Dean at the University of Michigan and a Technical Staff member at the MIT Lincoln Laboratory.

Prof. Pang has over 400 technical articles, book chapters, and invited presentations. She holds thirteen patents in the fields of nanotechnology and microsystems, with two more pending. Her research primarily focuses on the development of nanofabrication technology for applications in biomedical, microelectromechanical, THz, and meta-devices. Prof. Pang is a Fellow of IEEE, the ECS, the AVS, the HKIE, and HKAES.

Micrograph Contest



The research being done by the EIPBN community is at the leading the drive to develop the technologies required to make smaller and smaller structures.

We have ventured into size regimes where we are dependent on microscopes and the skill of microscopists to see the results of our work. To highlight the importance of micrographs to our community, EIPBN holds an annual micrograph contest.

In this, 29th Annual EIPBN Bizarre and Beautiful Micrograph Contest, we encourage our community to pick their favorite micrographs. Micrographs need not be related to research or to any paper or topic presented at the conference. Submissions may be purely for their beauty and ability to excite curiosity.

There is still time to take your shot at joining the elite company of the winners who have gained Micro-Fame and Nano-Fortune. Entries must be of a single image taken with a microscope and shouldn't be significantly altered.

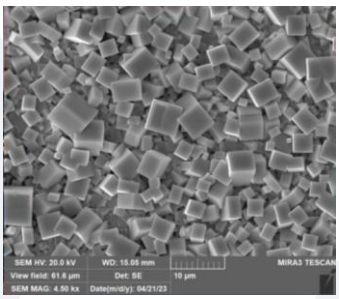
There are micro-cash prizes for the winners of each category. See the EIPBN website to enter. Entries should be submitted by May 27, 2024.

For additional information, contest entry forms, contest rules, and past winners, click here.

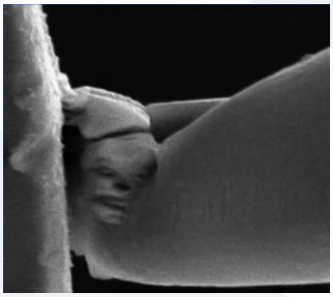
The 2023 Bizarre and Beautiful Micrograph Contest Winners

zyvex LABS

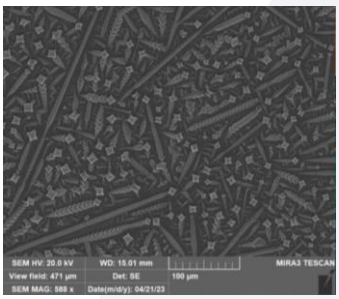
Grand Prize



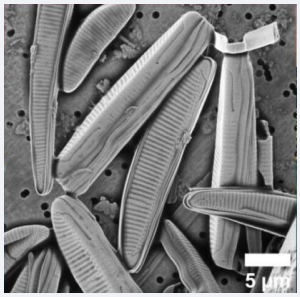
3-Beamers Choice



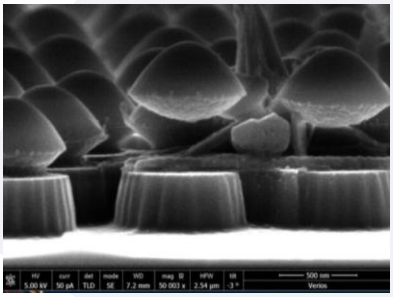
Best Electron



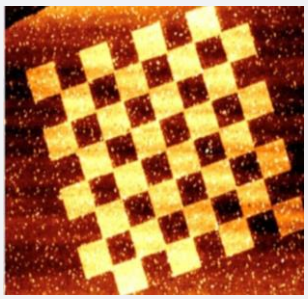
Best Ion



Most Bizarre



Best Scanning Probe



Best Photon

Commercial Session

The Commercial Session features material and equipment vendors which are relevant to the to our community. This year's session features 30 exhibitor booths plus the startup contest runners up in one collective booth and the startup winner in their own booth. The Commercial Session provides opportunity to meet with vendors who are eager to discuss their latest lithography systems, materials, characterization instruments and related products.

Make sure to check out Industrial Highlights Session 3C on Thursday, May 30 at 8:00 am for in-depth discussions about the research being done by our exhibitors. Don't miss the chance to engage the speakers during the Commercial Session to ask questions or continue the discussion.

The popular Exhibitor Lightning Session is held at noon in the Commercial Session on Wednesday, May 29, 2024 from 11:15 am – 12:15 pm.

Commercial Session Schedule

Tuesday, May 28th: 4:00 pm to 7:00 pm

Wednesday, May 29th: 10:00 am to 5:00 pm

Thursday, May 30th: 9:00 am to 1:00 pm

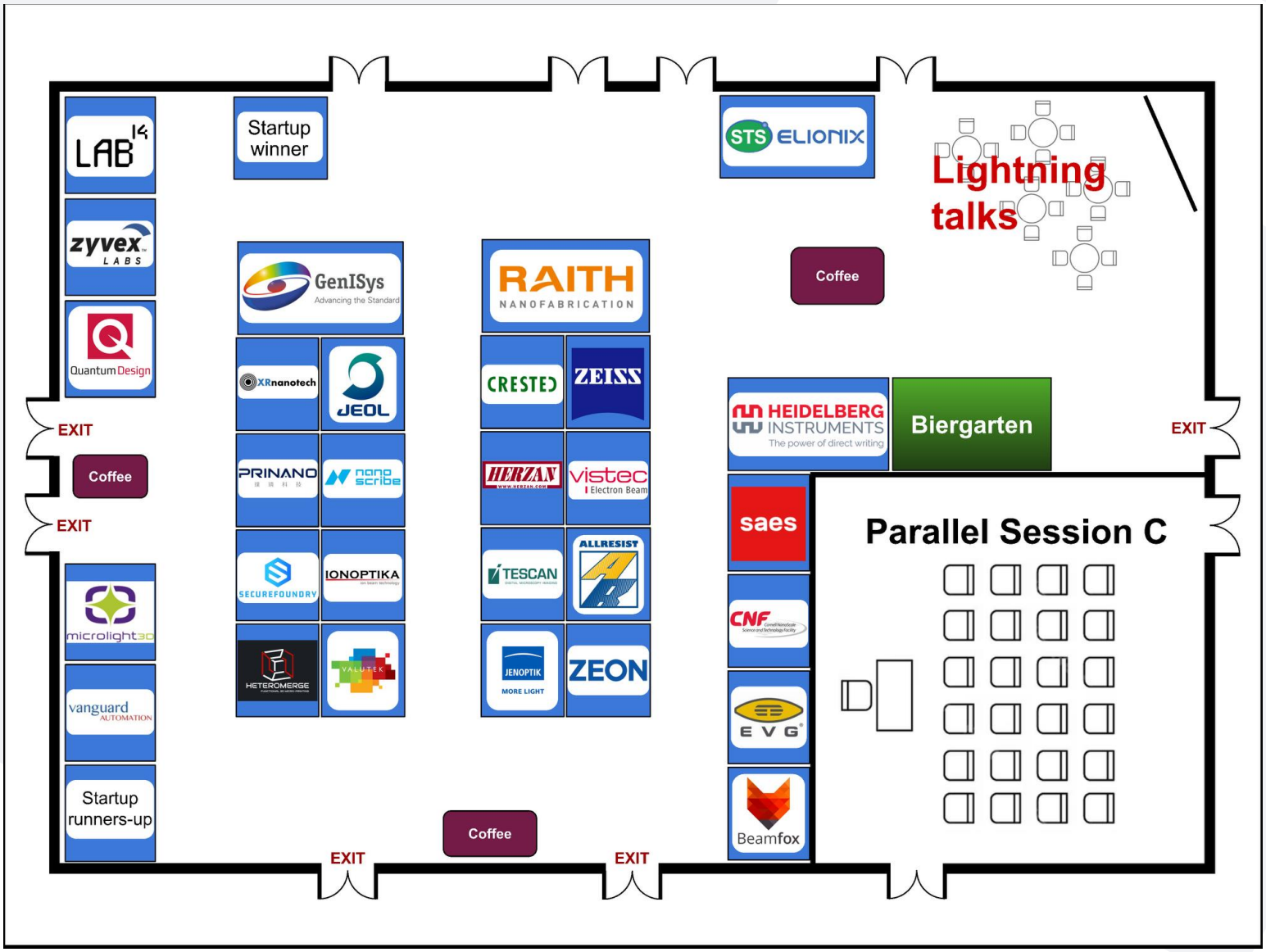
$100 Grand Prize!

Collect your raffle card at registration and sign-in at every booth during the Commercial and Poster Sessions to enter a raffle for a $100 cash prize!

Beamfox, HETEROMERGE, JENOPTIK MORE LIGHT, saes, EVG, nanoscribe A BICO COMPANY, HERZAN WWW.HERZAN.COM, CRESTEC, RAITH NANOFABRICATION, ALLRESIST, LAB14, GenISys, CNF Cornell NanoScale Science and Technology Facility, Quantum Design, STS ELIONIX, TESCAN PERFORMANCE IN NANOSPACE, HEIDELBERG INSTRUMENTS The power of direct writing, PRINANO 瑾 璘 科 技, SECUREFOUNDRY, ZEON, vanguard AUTOMATION, zyvex LABS, IONOPTIKA ion beam technology, OREGON PHYSICS High Brightness Ion Beams, ZEISS, VALUTEK, vistec Electron Beam, XRnanotech, microlight3D, JEOL

Commercial Session (continued)

This year, long time exhibitor and sponsor, Heidelberg Instruments, is celebrating their 40th anniversary and 25 years in the USA! There will be a Biegarten celebration in the exhibit hall on Wednesday, May 29th, 4pm - 5:45pm See the Heidelberg team at booth #309 for more details.



EIPBN Best Student Paper Award

This year EIPBN is holding the annual Best Student Paper Award competition that highlights outstanding student contributions and fosters the next generation of leaders in the EIPBN community. The competition includes two categories:

- The Best Student Poster Award will be given to the best poster presentation based on technical content, visual organization, and Q&A.
- The Best Student Presentation Award will be given to the best oral presentation based on technical content, clarity, and Q&A.

All student presenters are automatically entered into the competition. A team of three judges, selected by the Steering Committee, will evaluate the presentations and posters of the finalist during the conference. The Best Student Poster Award winner will be announced during the banquet, and the Best Student Presentation Award winner a week after the conference. The winning paper in each category will each receive a $500 prize and an award plaque.

The winners are also invited to give an Invited Poster Presentation at the 2023 Micro and Nano Engineering (MNE) conference, the EIPBN's sister conference in Europe, in Montpellier, France.

This year the Best Student Paper Award is generously sponsored by **JEOL USA.**

JEOL

Submit Your JVST B Manuscript

Papers presented at EIPBN 2024 shall be submitted for publication in a Special Collection within the *Journal of Vacuum Science and Technology B (JVST B)*. The deadline for manuscript submission to *JVST B* is Wednesday, July 31, 2024. All manuscripts are reviewed to the same standards as regular JVST submissions. For more information, see https://eipbn.org/manuscripts/.

Submit your manuscripts to JVST B using the journal's online manuscript submission system at the JVST Peer X-Press site: https://jvstb.peerx-press.org. Authors should select "Article" as the type of paper within the conference special collection (not Letter, Note, etc.). It is very IMPORTANT that authors indicate that your paper is a part of this Special Collection by choosing this year's EIPBN Collection from the drop-down list in the Manuscript Classification tab.

JVST B Best Journal Paper Award

Each year the editors of the JVST B select the EIPBN Conference Proceedings Best Journal Paper. The winning authors share a cash award and each author is presented with a certificate acknowledging their exceptional accomplishment. The award will be announced, and presentations made at the following year's conference banquet.

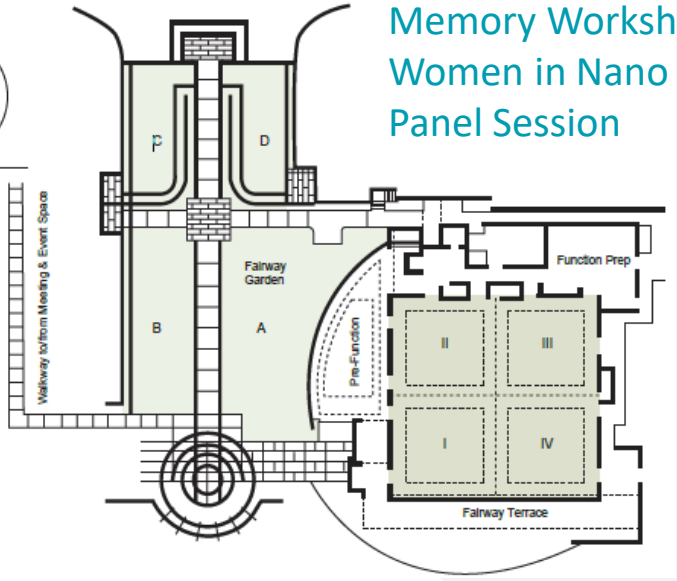
Congratulations to the winners of the 2023 *JVST B* Best Journal Paper Award!

"High-efficiency metalenses for zone-plate-array lithography"
By Henry I. Smith, Mark Mondol, Feng Zhang, Timothy Savas, and Michael Wals
Journal of Vacuum Science & Technology B 41, 062601 (2023); https://doi.org/10.1116/6.0003024

Hilton Floorplan

Exhibit Hall – Grande Ballroom ABCD
Parallel Sessions – Scripps I/II and Grande E
Posters - Grande Pre-Function/Foyer
Welcome Reception – Ballroom Terrace & Upper Parterre Garden
Banquet – Ballroom Terrace & Parterre Gardens

Fairway Ballroom:
Plenary Session
Memory Workshop
Women in Nano
Panel Session



Hilton
LA JOLLA TORREY PINES

Hotel: 858.558.1500 | **Sales:** 619.270.2600 | **Catering:** 858.450.4547
10950 North Torrey Pines Road | La Jolla, CA 92037
www.hiltonlajollatorreypines.com | santp-salesadm@hilton.com

Hotel and Banquet

Hilton La Jolla Torrey Pines
10950 N Torrey Pines Rd | La Jolla, CA 92037
Tel: (858) 558-1500
Website: www.hilton.com

Hilton La Jolla Torrey Pines Amenities

The Hilton La Jolla Torrey Pines is steps away from the Torrey Pines Golf Course, with views of the Pacific Ocean from our rooms with balconies and patios. Explore the natural beauty of Torrey Pines State Reserve nearby, with a walking trailhead to Torrey Pines State Beach one mile away. Enjoy an on-site restaurant offering in-room dining, two large outdoor gardens, a pool, and tennis and pickleball courts.

Conference Banquet

The 2024 banquet will be on Thursday, May 30, in the Parterre Gardens and Terrace in the Hilton La Jolla Torrey Pines overlooking the famous Torrey Pines Golf Course and Pacific Ocean. The banquet will feature local musical duo Johnny and Farah, who will play a selection well-known classics and contemporary/top 40 selections.

MNE 2024 | 50th International Micro and Nano Engineering Conference

September, 16th > 19th | Montpellier | France

Scientific Tracks

- Conf Chair : Dr C. Vieu, cvieu@laas.fr
- Program Chair : Dr L. Malaquin, lmalaqui@laas.fr

T1 : METHODS & PROCESSES : Micro-Nano Fabrication Methods and Processes

T2 : STRUCTURES & DEVICES : Fabrication and Integration of Micro-Nano structures, and devices

T3: SYSTEMS : Micro-Nano Systems for computing, communication, sensing and quantum applications

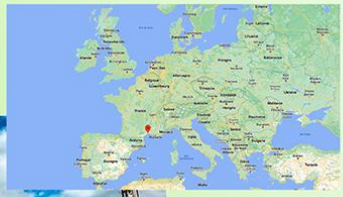
T4: BIO : Micro-Nano Engineering for Life or Analytical Sciences

T5: SUSTAINABILITY, Energy efficiency, Environmental or Ecological applications

Tutorials

BIOELECTRONICS
SUSTAINABLE PROCESSES FOR MICRO/NANO ELECTRONICS
ENVIRONMENTAL SENSORS
LIFE CYCLE ASSESSMENT METHODOLOGY IN MICROELECTRONICS

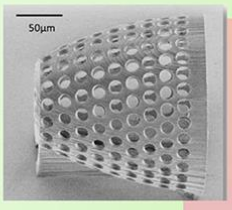
MONTPELLIER, South of France

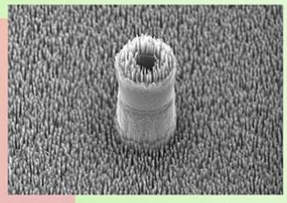


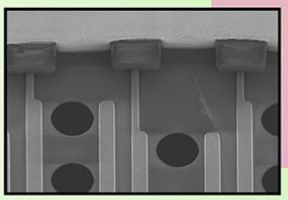
Upcoming Event

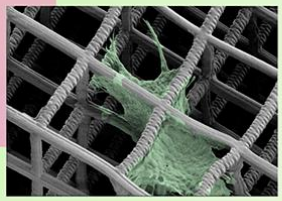
https://mne2024.imnes.org/

SEE YOU Next September in MONTPELLIER: 50 years of MNE conferences









https://mne2024.imnes.org/

37th International Microprocesses and Nanotechnology Conference

MNC 2024

Micro Nano Conference

URL: https://imnc.jp/2024/

November 12-15, 2024

Kyoto Brighton Hotel, Kyoto, Japan

Sponsored by The Japan Society of Applied Physics

PLENARY

Dr. Yoshihisa Kagawa, Sony Semiconductor Solutions Corp., Japan
Others under appointment

SYMPOSIUM

Symp. A: The Path to Sustainable Lithography
Symp. B: Process and Device Technologies for Quantum Computing
Symp. C: Innovative Technology to Regulate Living Body

COMMITTEE CHAIRS

Organizing Committee Chair:
Toshiyuki Tsuchiya (Kyoto Univ., Japan)
Steering Committee Chair:
Takahiro Namazu (Kyoto Univ. of Advanced Sci.,Japan)
Program Committee Chair:
Koji Asakawa (Kioxia, Japan)

ABSTRACT DEADLINE: June 10- July 1, 2024

Deadline of Early Bird Registration: Oct. 20, 2024

A UNITED CONFERENCE:

NNT LUND 2024 NIL ID

24-27 JUNE 2024, SWEDEN

This year the two most reputed conferences related to Nanoimprint and Nano-printing, the International NNT conference and the European NIL Industrial Day will be merged.

This joint conference will take place in Lund, Sweden from June 24-27, 2024.

It will feature high quality oral talks as well as a poster session and industrial exhibition.

Program Overview

Approx. time	Monday June 24	Tuesday June 25		Wednesday June 26		Thursday June 27
09:00	A UNITED CONFERENCE: NNT LUND 2024 NIL ID 24-27 JUNE 2024, SWEDEN	Company and Lab Visits	Exhibition setup	Session 3	Exhibition	Session 7
10:30				Session 4		Session 8
12:00	Registration	Lunch Break	Exhibition	Lunch Break		Farewell
14:00	Tutorials	Welcome Session		Session 5		Lunch Break
16:00		Session 2		Session 6		Additional Company and Lab Visits
19:00	Welcome Reception	Evening Session with Dinner		Conference Banquet		

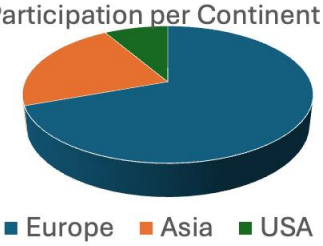
Status as of June 25

120 Registered participants

30 Exhibitors

17 Nations

Participation per Continent



A UNITED CONFERENCE: NNT LUND 2024 NIL ID 24-27 JUNE 2024, SWEDEN

We wish you a warm welcome to Lund

Chairs: Lars Montelius & Arne Schleunitz

MAEBL

MEETING FOR ADVANCED E-BEAM LITHOGRAPHY

Georgia Institute of Technology

Marcus Nanotechnology Building

September 24 – 26, 2024

Atlanta, Georgia, USA

Online and In-person

Register

View Program

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Platinum Charter Sponsors

RAITH NANOFABRICATION

GenISys

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CLEANROOM LABWARE

Silver Charter Sponsor

DisChem CHEMISTRY FOR ADVANCED LITHOGRAPHY

Charter Sponsors

ALLRESIST

JEOL

Silver Sponsor

TESCAN PERFORMANCE IN NANOSPACE

SPIE. ADVANCED LITHOGRAPHY+ PATTERNING

23 – 27 February 2025
San Jose, California, US

Abstract deadline: Sep 19, 2024

Symposium Chairs

Qinghuang Lin
LinkTek Int.

John Robinson
KLA Corp.

Conferences

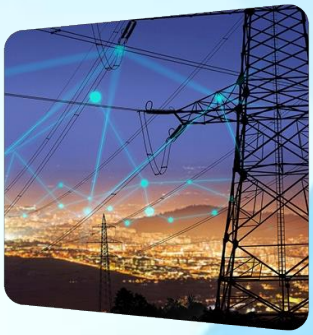
- Optical and EUV Nanolithography
- DTCO and Computational Patterning
- Metrology, Inspection, and Process Control
- Novel Patterning Technologies
- Advances in Patterning Materials and Processes
- Advanced Etch Technology and Process Integration for Nanopatterning

Student Opportunities

- Student Grants
- Nick Cobb Memorial Scholarship
- Best paper awards (see program details)

SPIE. ADVANCED LITHOGRAPHY+ PATTERNING




IEEE Nanotechnology Council (IEEE NTC)

The IEEE Nanotechnology Council is a multi-disciplinary group whose purpose is to advance and coordinate work in the field of Nanotechnology carried out throughout the IEEE in scientific, literary and educational areas. The Council supports the theory, design, and development of nanotechnology and its scientific, engineering, and industrial applications.

Become a member of the Nanotechnology Council is for free.

IEEE NANO Nanotechnology Council®

IEEE Advancing Technology for Humanity

IEEE NANO Nanotechnology Council®

IEEE NTC Technical Activities

The NTC Technical Activities are developed in the **Technical Committees (TCs)** and **Chapters.**

1. Nanorobotics and nanomanifacturing
2. Nano-biomedicine
3. Nanofabrication
4. NanoOptics, Nano-Photonics and Nano-Optoelectronics
5. Spintronics
6. Nanoelectronics
7. Nanosensors and Nanoactuators
8. Nanomaterials
9. Nano-Metrology and Characterization
10. Modeling and Simulation
11. Nanopackaging
12. Nanomagnetics
13. NanoEnergy, Environment and Safety
14. Nanoscale communications
15. Nanoacustic devices, processes and materials
16. Quantum, Neuromorphic, and Unconventional Computing
17. Emerging Plasma Nanotechnologies
18. Nanotechnology for Soft Electronics

Professional Chapters (47) and **Student Branches** (42) in the NTC areas of interest in several countries list -> https://ieeenano.org/technical-activities/chapters/

IEEE Advancing Technology for Humanity

Conference App
Guidebook

Follow Instructions Below to Access The EIPBN 2024 Guidebook on the Guidebook App

1) Scan the QR code with a phone camera.

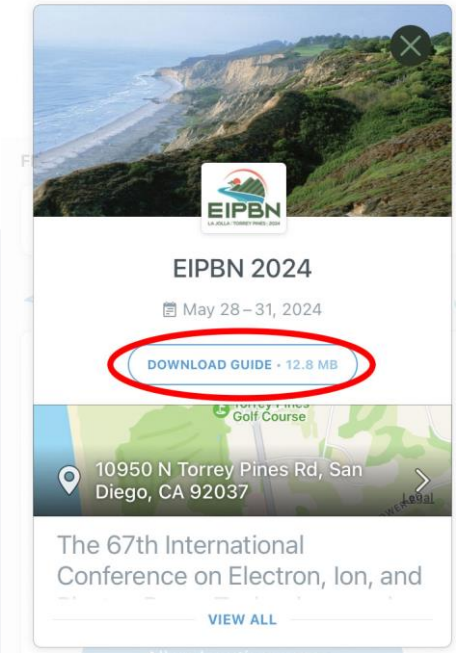
If you don't already have the app installed on your mobile device, you will first have to install it.

2) After the Guidebook app opens, it will ask for a passphrase.

Enter:

ow5veb3h
(o is a lowercase letter o)

3) Tap **Download Guide** button.



DisChem

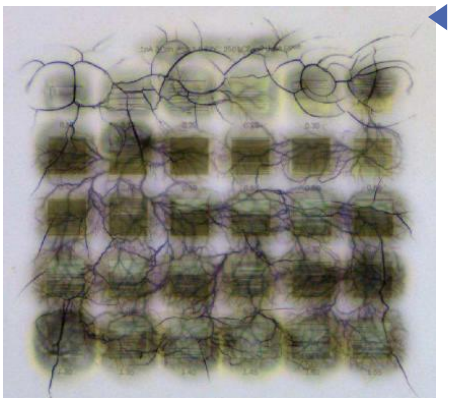
CHEMISTRY FOR ADVANCED LITHOGRAPHY

DisCharge+

EBL ANTI-CHARGING AGENT

- Improved shape fidelity and positional accuracy for EBL resist patterning on insulating substrates such as fused silica, quartz, glass, PDMS, etc.
- Water based w/ excellent wetting properties. Spin coat application provides conductive film for anti-charging.
- Suitable for nondestructive SEM imaging of nonconductive materials.
- Easy residue free removal w/ water or IPA.
- Competitively priced. Ideal for both research and industrial applications.
- Two-year shelf life at room temp. Highly stable permanently charged non-polymer formulation.
- Ready to use. No filtration required prior to use.

WITH DisCharge: no charge accumulation, resulting in expected image with no harm to PDMS layer.



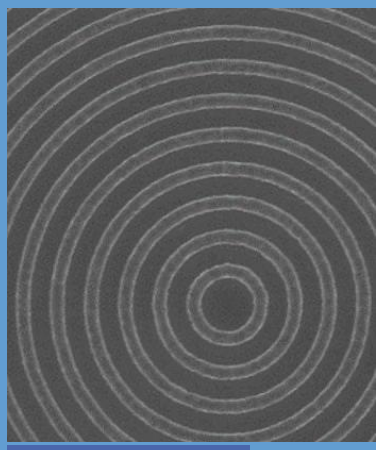
Without DisCharge: charge accumulation and sudden charge dissipation caused by exceeding the dielectric breakdown strength of the PDMS to the Si substrate resulting in significant image distortion in the resist and destruction of the PDMS surface.

anti-charging

H-SiQ *(hydrogen silesquioxane)*

NEGATIVE-TONE ELECTRON BEAM RESIST

DisChem H-SiQ is a negative tone hydrogen silesquioxane (HSQ) resist in MIBK carrier solvent for use in electron beam lithography (EBL). H-SiQ is characterized by excellent pitch resolution, sensitivity and etch resistance for direct write thin and thick film EBL applications. Immediate availability in quantities as low as 20 ml.

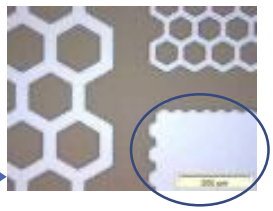


resist

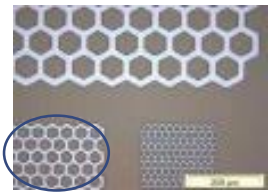
SurPass

RESIST ADHESION PROMOTERS

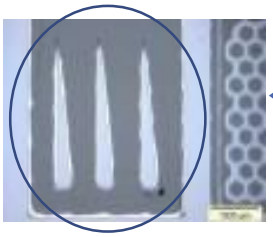
- Improved microlithographic resist adhesion on a broad range of substrate materials.
- Improved adhesion at low doses in electron beam lithography
- Improved removal of critical substrate contaminants
- Reduced z-potential for improved resist coating properties
- Improved patterned resist mold to copper seed layer for subsequent electroforming.
- Increased adhesion of evaporated metals to substrate materials
- Non-Hazardous waterborne formulation



No Adhesion Promoter: some patterns removed during resist development.



With SurPass: Complete Precision Mask



No Adhesion Promoter Resist Mask Undercut During Etching

With SurPass: Complete Precision Mask

adhesion promotion

DisChem, Inc., 17295 Boot Jack Rd, Ridgway, PA 15853 USA • Tel: +1-814-772-6603 • info@dischemInc.com • www.dischemInc.com

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Microoptics | Materials engineering | Life sciences | Micromechanics & MEMS | Microfluidics

Plenary Session

Wednesday, May 29, 2024, from 8:00 am to 10:45 am

Wednesday, May 29

Plenary Session
Room: Fairway Ballroom
Session Chair: Wei Wu, University of Southern California

8:00 am - Welcome
Aimee Bross Price, Conference Chair, The Ohio State University and Wei Wu, Program Chair, University of Southern California

8:30 am – Micro/nanofabrication Techniques for 3D Functional Mesosystems: From Neural Interfaces to Environmental Monitors, John A. Rogers (Northwestern University)

Complex, three dimensional (3D) micro/nanostructures in biology provide sophisticated, essential functions in even the most basic forms of life. Recent advances in micro/nanofabrication and assembly provide access to diverse classes of electronics in 3D architectures, with characteristic dimensions from nanometers to centimeters, over areas that span square centimeters or more. This talk reviews the key concepts, with applications in electronic mesoscale networks as neural interfaces and in bio-inspired microfliers as environmental sensing platforms**.**

9:15 am – Understanding and Controlling Charge, Heat, and Spin at Atomically Precise Interfaces, P. S. Weiss (UCLA)

By having developed the "eyes" to see, to record spectra, and to measure function at the nanoscale, we have been able to fabricate structures with precision, thereby controlling the physical, electronic, mechanical, thermal, and chemical connections that materials make to one another and to the outside world.

10:00 am – Trends and future directions in logic technologies: research challenges and opportunities, Carlos H. Díaz (Taiwan Semiconductor Manufacturing Company)

Sustainable growth in computing performance supporting expanded functional capabilities of information technology and communication products requires energy-efficiency breakthroughs in underlying technologies. This talk will overview emerging devices and interconnect fabrics, their challenges, and research opportunities aimed to identify viable alternatives beyond those of the projected evolutionary paths of current state-of-the-art logic technologies.

Oral Presentations

Wednesday, May 29

1A-Advanced micro/nanolithography 1
Room: Scripps Ballroom 1
Session Chairs: Paul Weiss (UCLA), Chih-Hao Chang (UT Austin)

1:20 pm 1A1 Invited
Dry Resist Patterning Progress and Readiness Towards High NA EUV Lithography
Anuja De Silva (Lam Research)
We aim to demonstrate the progress of dry resist development to address specific challenges of high NA EUV lithography. As features scales, resist thickness and interface between resist and underlayer play a crucial role. The co-optimization of underlayers with dry technology enables tuning of the patterning stack for optimal performance.

1:50 pm 1A2 Regular
Pattering via EHD and inkjet printers
Niels Wijnaendts van Resandt, Maximilian Mosberg (LAB14, Notion-systems)
Electrohydrodynamic (EHD) printing is a new high-resolution printing technology. We will present a new research and development tool which utilizes proprietary MEMS-based multi-nozzle EHD printheads, enabling print resolutions below 1 µm. This exceeds that of conventional inkjet printing by two to three orders of magnitude.

2:10 pm 1A3 Regular
Intra-Level Mix & Match investigations of negative tone photoresists mr-EBL 6000.5 and maN 1402 for i-line stepper and electron beam lithography
Christian Helke, Sebastian Schermer, Susanne Hartmann, Anja Voigt and Danny Reuter (Fraunhofer Institute for Electronic Nano Systems (ENAS)) This paper presents the investigation of two negative tone resists mr-EBL 6000.5 and ma-N 1402 for an Intra-Level Mix & Match approach with i-line and electron beam lithography on the same resist layer, providing the advantage of resolving patterns of different dimensions with fewer process steps and shorter processing time.

2:30 pm 1A4 Regular
Thermal scanning probe lithography (t-SPL) enabled high-resolution lift-off process
M. Käppeli, J. Chaaban, N. Hendricks, E. Çağın (Heidelberg Instruments Nano AG)
Nanoscale structures with a resolution in the 10s of nanometres can be achieved using the NanoFrazor t-SPL tool and its associated processes. A multilayer high-resolution lift-off process post-t-SPL allows the creation of non-repeating structures as small as 20 nanometres. Best practices for high-resolution patterning and lift-off will be presented.

2:50 pm 1A5 Regular
High-quality 3D Printing of Micro-Optical Elements with 3D two-photon grayscale lithography (2GL®)
Arwin Shrestha, Matthias Blaicher, Andrea Bertoncini, Roman Reiner, Mareike Trappen, Stephan Dottermusch, Nicole Lindenmann, Philipp Rayling, Kai Sandfort, Benjamin Richter, Tobias Hoose and Michael Thiel (Nanoscribe GmbH & Co. KG)
3D generalization of Nanoscribe's two-photon grayscale lithography (2GL®) process, 2GL® is, a method that uses a fast laser power modulation to avoid layer-discretization artifacts thus resulting in smooth surfaces even for a large spacing between exposure layers. Our approach achieves a ten-times speedup compared to traditional layer-based two-photon lithography.

1B-Directed self-assembly
Room: Scripps Ballroom 2
Session Chairs: Alex Liddle (NIST), Wei Wu (USC)

1:20 pm 1B1 Invited
Exploring the Versatility of End-Grafted Polymer Brushes for High-Precision Nanopatterning
Ricardo Ruiz (Lawrence Berkeley National Laboratory)
We explore end-grafted polymer and peptoid brushes for nanoscale surface modification. Integrated with advanced lithographic techniques, these brushes enable precise adsorption, interfacial tuning, and interfacing between inorganic surfaces and biological matter. We showcase examples ranging from biomimetic polymers for semiconductor/bio interfaces to directed self-assembly for EUV lithography and selective deposition

1:50 pm 1B2 Regular
Fabricating bimodal pore size membranes as a platform to understand nanoscale aqueous transport behavior
Wen Chen, Jamila Eatman, Seth B. Darling and Paul F. Nealey (University of Chicago)
We hypothesize that precise nanofabrication of bimodal membranes, rather than those with a continuum of pore sizes, will enable assessment of the impact of structural defects as well as flux partitioning.

2:10 pm 1B3 Regular
Fabrication of chemical patterns from negative resist for directed self-assembly at resolution limits of lithography
Kyunghyeon Lee and Paul F. Nealey (University of Chicago)
A new fabrication strategy for high-resolution chemical patterns in DSA is introduced, utilizing a negative tone resist. HSQ patterns, created by e-beam lithography, are transformed into Cr patterns through reactive ion etching and further converted into chemical patterns with sequential polymer brush grafting, reaching a 24 nm full-pitch resolution.

2:30 pm 1B4 Regular
Thin polymer blends films as a tool for creating patterned metals, semiconductors, SAMs and brushes
Stefan Walheim, Roland Groeger, Cheng Huang, Tobias Heiler, Markus Moosmann, Jonathan Berson and Thomas Schimmel (KIT Karlsruhe Germany)
Polymer phase separation can generate billions of structures in a few seconds during spin coating. These structures can be used as templates to obtain structured metals, semiconductors, SAMs or polymer brushes. The control of the phase behaviour of the polymers by pre-structured substrates allows a controlled geometry of the morphology.

2:50 pm 1B5 Regular
Fabricating 3D Nanostructures Through Colloidal Extreme Ultraviolet Lithography
Saurav Mohanty, Ethan Fermin Flores and Chih-Hao Chang (The University of Texas at Austin)
This work explores 3D nanopatterning using 30 nm wavelength extreme ultraviolet (EUV) light to surpass optical diffraction limits. Sub-200 nm diameter nanoparticles are used as near field phase mask to perform single shot Talbot lithography exposure. The results demonstrate sub 50 nm resolution patterns, promising for future photonic crystal applications.

1C-Nanofabrication for quantum computing
Room: Grande Ballroom E
Session Chairs: John Randall (Zyvex Labs), Regina Luttge (Eindhoven U. of Tech.)

1:20 pm 1C1 Invited
Single-electron qubits on solid neon
Xinhao Li, Xianjing Zhou, Christopher Wang, Yizhong Huang, Brennan Dizdar, Xu Han, David I. Schuster and Dafei Jin (Argonne National Laboratory)
We demonstrate the strong coupling between the charge states of single electrons trapped on solid neon with photons in a superconducting resonator. The coherence lifetimes of the electron qubits achieve 0.1ms scale, outperforming all existing traditional charge qubits. Further development of this novel qubit calls for advancements in quantum nanofabrication.

1:50 pm 1C2 Regular
Exploring electroluminescence and transport of color center light-emitting diodes as candidates for telecom quantum light sources
Nikki Ebadollahi, Vijin V. Kizhake, Marcelo I. Davanco, Kartik A. Srinivasan, Pradeep N. Namboodiri, Aaron M. Katzenmeyer, Matthew Pelton and Joshua Pomeroy (National Institute of Standards and Technology)
We fabricate color center light-emitting diodes (CC-LEDs) in silicon to assess their electrical and optical properties to assess whether they can be used as telecom O-band quantum light sources. The ultimate goal of our work is to enable on-chip electroluminescence (EL) from CCs.

2:10 pm 1C3 Regular
Robust and Simplified Gate Design in Surface-Gated Quantum Dot Devices for Diagnostic Qubits Fabrication
Seyed Amirali Arefpour, Adrian Li, Joshua M. Pomeroy and Nikki Ebadollahi (National Institute of Standards and Technology, Gaithersburg, MD)
Our research at NIST focuses on developing robust, simple gate designs for surface-gated quantum dot devices, aiming to produce diagnostic qubits with reduced failure rates. We prioritize compact gate structures and material characterization, exploring the effects of gate shapes on quantum dot functionality and device reliability.

2:30 pm 1C4 Invited
A piezo-optomechanical transducer for quantum entanglement between light and microwaves
Srujan Meesala (California Institute of Technology)
We will discuss the design and fabrication of piezo-optomechanical devices for transduction between quantum states at microwave and optical frequencies. These devices feature nanoscale photonic, mechanical, and superconducting microwave elements on a single chip. Recently, we used such an integrated transducer to generate entangled pairs of optical and microwave photons.

3:00 pm 1C5 Regular
Area Selective Chemical Vapor Deposition of Gold by Electron Beam Seeding
Aleksei Tsarapkin, Krzysztof Mackosz, Chinmai S. Jurredy, Ivo Utke and Katja Hoeflich
This work presents a novel maskless patterning technique that enables area selective CVD of gold. A focused electron beam is used to decompose the metal-organic precursor Au(acac)Me2 locally, thereby creating an autocatalytically active seed layer for subsequent CVD with the same precursor.

2A-Atomically precise fabrication
Room: Scripps Ballroom 1
Session Chairs: Michael Titze (Sandia), Martha Sanchez (Applied Materials)

3:30 pm 2A1 Invited
Next generation fabrication techniques for top gated qubits in silicon
James Owen, Joshua Ballard, Ehud Fuchs and John Randall (Zyvex Labs)
We describe two methods to create atomically precise or near atomically precise quantum computer architectures using functionalized scanning tunneling microscope lithography (STM). In one method, patterns are functionalized into 2D delta layers. In the other method, the STM patterns are converted into nanoimprint templates for scalability.

4:00 pm 2A2 Regular
High resolution metal deposition using focused electron beam with redox chemistry control
Auwais Ahmed, Peter A. Kottke and Andrei Fedorov (Georgia Institute of Technology)
We present an 'electrochemical lensing' approach for focused electron beam mediated nanomaterial synthesis that locally creates favorable electrochemical environment at the electron beam impingement site, while suppressing unwanted growth in the surroundings. The approach enables rapid creation of high-resolution nanostructures.

4:20 pm 2A3 Regular
Scanning Probe Atom-by-atom Fabrication of Phosphorus in Silicon Devices
Jonathan Wyrick, Pradeep Namboodiri, Fan Fei, Brian Courts, Utsav Utsav and Richard Silver (NIST)
We describe use of a scanning tunneling microscope to achieve a measured incorporation yield of 100% for single P atoms imbedded in silicon for quantum devices. We also discuss progress on B imbedding, as well as design and fabrication of fully functioning atomic precision devices.

4:40 pm 2A4 Regular
Fabricating Atomically Precise Devices to Engineer Unique Quantum Properties
Rick Silver, Fan Fei, Pradeep Namboodiri, FNU Utsav, Brian Courts, Joshua Pomeroy and Jonathan Wyrick (National Institute of Standards and Technology)
We are using atomically precise manufacturing to fabricate few-donor/quantum dot devices in silicon for use as qubits and arrays of atomic clusters to simulate quantum materials. To scale up we must control atomic fabrication processes with true atomic precision and understand the impact each atom has on device performance.

5:00 pm 2A5 Regular
Fabrication and characterization of 10-nm-diameter nanopore arrays for applications in mask-based metastable atom-beam lithography
Bhera Ram Tak, Riley Gatensby, Robert O'Meara, Clive Downing and Richard G. Hobbs (School of Chemistry, Trinity College Dublin)
Large-scale pattern generation with 1-nm resolution remains challenging for nanofabrication. Holographic mask-based He* atom lithography, where He* passes through nanoscale holes in dielectric membranes offers nanoscale pattern generation. We present 10 nm size nanohole arrays in SiNx membranes, crucial for advancing atom beam lithography.

2B-Metamaterials, metasurfaces, and meta-optics 1
Room: Scripps Ballroom 2
Session Chairs: Stefano Cabrini (start-up), Wen-Di Li (University of Hong Kong)

3:30 pm 2B1 Invited
Symmetry and Topology in Photonic Nanostructures
Abdoulaye Ndao (UCSD)
The quest for smaller, lighter, and more efficient optical components usually comes at the price of reduced functionalities. provide an overview of how topological approaches to control light-matter interaction enable novel photonic devices with unique features and enhanced performance.

4:00 pm 2B2 Regular
Three-Dimensional (3D) Subwavelength-Thick Plasmonic Nano-Tiles on Terraces: Broadband, Omni-Angle, Near-100% Light Trapping and Absorption, Fabricated by a Single Nanoimprint Step over a Large Area
Stephen Y. Chou (Princeton University)
We propose and experimentally demonstrate (a) a new type of 3D nanoplasmonic light-trapping/absorbing structure, termed "plasmonic nano-tiles on terrace" (PlaNTT), which absorbs light near 100%, broadband, and omni-angle acceptance with a thickness 1/10 to 1/2 of the light wavelength; and (b) a one-step nanoimprint for patterning the 3D structures.

4:20 pm 2B3 Regular
Broadband spin and angle co-multiplexed six-channel metahologram based on a flat waveguide
Zeyang Liu, Hao Gao, Taigao Ma, Vishva Ray, Cheng Zhang and L. Jay Guo (University of Michigan, Ann Arbor)
We present a new type of waveguide-based multi-channel metaholograms, which can support six independent and fully crosstalk-free holographic display channels, simultaneously multiplexed by the spin and angle of guided incident light within the glass waveguide

4:40 pm 2B4 Regular
Bilayer Meta-optics in Visible Wavelengths for Moiré Flatbands
Suki Gu, Tianzhe Zheng and Andrei Faraon (California Institute of Technology)
A bilayer TiO2/air meta-optics is fabricated for demonstrating moiré flatbands in visible wavelengths. The fabrication process combines E-beam lithography and ALD back-filling. This approach enables multilayer visible structures with closely stacked layers and a refractive index contrast of approximately 2.4.

5:00 pm 2B5 Regular
A binder-free porous medium of interwoven CuO microstructures for energy storage
Carly Flynn, Alison H. McCarthy, Jason Alexander Röhr and Mohsen Azadi (University of Pennsylvania)
A simple and scalable top-down fabrication method for a binder-free porous interwoven and continuous CuO microstructure medium formed from an underlying Cu substrate for use as anodes in Li-ion batteries. Structures can be covered by a secondary layer of active material, such as Si or Ge to without jeopardizing porosity.

2C-MEMS/NEMS and Micro/nanofluidics
Room: Grande Ballroom E
Session Chairs: Rebecca Cheung (U. of Edinburgh), Gina Adam (George Washington University)

3:30 pm 2C1 Invited
Nano Injection Molding for Nanofluidic Devices
Sunggook Park, Michael C. Murphy and Steven A. Soper (Louisiana State University)
Despite recent advancement in nanofluidic devices and applications, their high rate and low cost manufacturing tools are still lacking. This paper will discuss recent progresses on transitioning from NIL, a medium rate fabrication tool, to nano injection molding in the fabrication of nanofluidic devices.

4:00 pm 2C2 Regular
A Graphene-based Capacitive Monolithic Microphone with Minimized Air Gap Thickness
Yun Jiang, Graham S. Wood, Michael J. Newton, Peter Lomax and Rebecca Cheung (The University of Edinburgh)
We report a graphene-based microelectromechanical systems (MEMS) capacitive microphone with a 1.5 micrometer air gap and a vent hole. The design, fabrication and characterization of the microphone is introduced.

4:20 pm 2C3 Regular
Relating Unidirectional and Bidirectional Single Cell Migration with Oxygen Imaging
Muting Wang and Stella Pang (City University of Hong Kong)
This study investigated the relationship between single cell unidirectional and bidirectional migration and oxygen consumption, using PtOEPK dye as an oxygen sensor. The findings revealed that peaks of oxygen consumption occurred when cells changed their migration direction, offering a crucial groundwork for investigating cell activities and viability in tissue engineering.

4:40 pm 2C4 Regular
Localization of microparticles by a patterned drying process surface energy techniques
Yian Cheng and L. Jay Guo (University of Michigan, Ann Arbor)
A microparticle localization technique using the drying patterned drying process surface energy. Created by hydrophobic and hydrophilic patterns with control of the surface tension and geometry, one can successfully localize particles to the center of the pattern.

5:00 pm 2C5 Invited
EIPBN 2024 Early Career Award Lecture
Pneumatic Enabled Nano-Sieve for Sensitive Detection of Pathogens in Blood
Ke Du (The University of California, Riverside)
We introduce a miniaturized nano-sieve device featuring a pneumatically-regulated chamber for highly efficient pathogen concentration from blood. Integration of this device with CRISPR assay, an on-chip detection limit of approximately 100 cfu/mL is achieved for antibiotic resistant bacteria. We further show an enhanced nano-sieve by incorporating "micro-grooves" for virus sensing.

WORKSHOP on EMERGING MEMORY INFRASTRUCTURE

EIPBN

AGENDA

Wednesday, May 29, 2024

Hilton La Jolla, Torrey Pines, San Diego

SESSION 1 (1:20 pm – 3:10 pm)

Emerging Memory Devices: Fabrication and Characterization

Speakers: Rehan Kapadia (USC/Mosis 2.0)
Brendan Hanrahan (ARL)

Panelists: Rehan Kapadia (USC/Mosis 2.0)
Brendan Hanrahan (ARL)
Joshua Yang (USC)
Cosmi Lin (Texas A&M)
Heayoung Yoon (U of Utah)

Moderator: Sarbajit Banerjee (Texas A&M)

BREAK (3:10 pm – 3:30 pm)

SESSION 2 (3:30 pm – 5:20 pm)

Emerging Memory Chips: Packaging and Testing

Speakers: Yi Huang (UMass Amherst)
Linda Katehi (Texas A&M)

Panelists: Yi Huang (UMass Amherst)
Qiangfei Xia (UMass Amherst)
Suin Yi (Texas A&M)
Michael Gaither (Texas A&M/TEES)

Moderator: Linda Katehi (Texas A&M)

The workshop is organized by TAMU, USC, and UMass under the sponsorship of NSF, Texas A&M Engineering Experiment Station (TEES), and DREAMS Hub, one of the eight regional innovation hubs established under the Microelectronics Commons Program. The abstracts submitted to this workshop were not peer reviewed by EIPBN committee.

Thursday, May 30

3A-Electron and ion beam lithography
Room: Scripps Ballroom 1
Session Chairs: Leonidas Ocola (IBM), Gerald Lopez (University of Pennsylvania)

8:00 am 3A1 Invited
What are the Challenges for Creating a Positive Tone Metal-Organic Resist?
Scott M. Lewis, Luisa Bozano, Guy A. Derose, Barbara Kazanowska, David Castilo-Lozada and Axel Scherer (California Institute of Technology)
We investigate a series of metal-organic nanocomposite positive-tone photoresist materials that are suitable for electron beam lithography. From our initial Monte Carlo studies, the nanocomposite resist performance demonstrated a resolution of 50 nm half-pitch while exhibiting a high resistance achieving a selectivity of >1:25.

8:30 am 3A2 Regular
Passive Tuning of Photonic Integrated Circuits by Automated Silicon Ion Implantation
Venkata Sai Akhil Varri, Shabnam Taheriniya, Frank Brückerhoff-Plückelmann, Ivonne Bente, Daniel Bernhardt, Achim Nadzeyka, Torsten Richter and Wolfram Pernice (University of Münster)
A key challenge in scaling integrated photonic systems is the sensitive nature of the components to fabrication imperfections. Here, we highlight a scalable and non-volatile technique for post-fabrication tuning of photonic computational memories by silicon ion implantation. We precisely align high-quality resonant devices to targeted wavelengths with picometer precision.

8:50 am 3A3 Regular
Advanced electron-beam grayscale lithography writing strategies using optimized dose gradients in the pattern design
Kevin Hofhuis, Nazanin Samadi, Christian David, Vitaliy A. Guzenko, Analía Fernández Herrero, Bas Ketelaars and Christiaan Zonnevylle (Paul Scherrer Institute)
Advancing electron-beam lithography: Implementation of novel dose gradient shaping in Raith EBPG Plus system for precision grayscale lithography writing strategies. The technique enable meticulous control over electron doses, yielding smoother structures. Successful integration enhances flexibility, reduces writing times, and facilitates the creation of intricate 3D patterns.

9:10 am 3A4 Regular
Focused Ion Beam (FIB) Patterning of Surface Nanobubbles
Anayet Ullah Siddique, Rui Xie and Roseanne Warren (University of Utah)
This research hypothesizes that nanoscale FIB-based patterning can effectively control surface nanobubble position employing chemical heterogeneity through selective removal of a hydrophobic self-assembled monolayer. The hypothesis is confirmed by analyzing bubble formation on silicon surfaces containing line patterns generated by selective FIB removal of octadecyltrichlorosilane (OTS).

9:30 am 3A5 Regular
Poly Acrylic Acid Patterning by Electron Beam Lithography
Devin K. Brown (Georgia Institute of Technology)
This work presents the first known results of the direct patterning of polyacrylic acid (PAA) hydrogel by electron beam lithography. Hydrogels are being investigated in emerging applications such as drug delivery, biosensors, tissue engineering, and wound healing bandages. Therefore, this work can enable lithographic patterning of PAA for those applications.

3B-Nanophotonics and plasmonics 1
Room: Scripps Ballroom 2
Session Chairs: Rajesh Menon (University of Utah), Sunggook Park (LSU)

8:00 am 3B1 Invited
Super-resolution imaging enabled by metamaterials
Zhaowei Liu (University of California San Diego)

8:30 am 3B2 Regular
Which way is up? Nanophotonic calibration artefacts for accurate molecular orientation measurements
James Liddle, Muneesh Maheshwari, Henri Lezec, Dhruv Fomra, kishalay mahato and John Fourkas (National Institute of Standards and Technology)
The polarization state of an optical signal can be altered by its passage through an imaging system, leading to biases in the detected signal. To measure these biases, identify their origin, and correct them, we introduce and demonstrate a nanophotonic calibration artefact and associated methodology.

8:50 am 3B3 Regular
Ultra-high Q Thin Film Lithium Niobate Resonators
Xinrui Zhu, Yaowen Hu, Shengyuan Lu, Hana K. Warner, Xudong Li, Yunxiang Song, Leticia Magalhaes, Amirhassan Shams-Ansari, Neil Sinclair and Marko Loncar (Harvard University)
Thin-film lithium niobate (TFLN) is a recently emerging versatile platform for integrated photonics. We present our design, fabrication, and characterization of TFLN microresonators with a record-high intrinsic quality (Q) factor of twenty-nine million, corresponding to an ultra-low propagation loss of 1.3 dB/m, further unlocking the potential of this platform.

9:10 am 3B4 Regular
Fabrication of Multilayer Nanolattice Reflectors with Integrated Low-Index Nanolattices
Vijay Anirudh Premnath, I-Te Chen and Chih-Hao Chang (The University of Texas at Austin)
Our research involves precise fabrication of multi-layer 3D periodic nanolattices with single, double, and triple stacks of Aluminium oxide and Titanium oxide layers. This architecture allows precise control of photonic bandgap and investigates the influence of lattice height in designing the wavelengths for the lattices with near 100% peak reflectance.

9:30 am 3B5 Regular
Shape Memory Micro/Nano-Pillar Arrays for Dynamic and Optical Spectrum Dependent Transmission Control
Yuanhao Xu and Stella Pang (City University of Hong Kong)
This study demonstrates the dynamic conversion of optical properties using high aspect ratio shape memory polymer (SMP) micro/nano-pillars fabricated by imprinting technology. The SMP structures enable precise control over diffraction patterns and wavelength-dependent transmission, opening avenues for tunable photonic devices and enhanced light manipulation.

3C-Industrial highlights
Room: Grande Ballroom E
Session Chairs: Emine Cagin (Heidelberg), Vishva Ray (University of Michigan)

8:00 am 3C1 Regular
VPG 300 DI - The Maskless Stepper from Heidelberg Instruments
Matthias Wahl, Christian Bach and Gregg A. Moore (Heidelberg Instruments, Inc.)
Derived from the VPG+ Volume pattern generator series mask making tools, the VPG 300 DI is specially designed for direct writing high-resolution microstructures in i-line photoresists. It includes all advanced VPG+ system components for high-precision exposures as well as features needed for direct write applications of sub-micron structures.

8:15 am 3C2 Regular
Algorithmic Patterning Workflow for EBL, a new FIB-SIMS System and massive parallel Laser direct Write – Latest Raith Innovations for Nanofabrication and -Analysis
Frank Nouvertne, Torsten Richter and Viacheslav Vlasenko (Raith GmbH)
Recent innovations spanning the entire Raith product portfolio will be presented. This includes a new efficient EBL workflow for nanofabrication of metalenses, a multiple laser beam based lithography solution for large area photonic crystals, a new FIB-SIMS system for nanoanalytics, and large area SEM imaging and metrology.

8:30 am 3C3 Regular
A New Generation in Thermal Scanning Probe Lithography
Emine Cagin (Heidelberg Instruments Nano AG)
Breakthroughs in throughput and maximum lithography area in thermal scanning probe lithography, made possible by the long-awaited parallelization and smart handling of large designs in software implementation will be demonstrated. Full parallel operation of the NanoFrazor is expected to enable further innovations in nanophotonics, nanoelectronics, and advanced materials research.

8:45 am 3C4 Regular
An Upgrade Package for SEM-based Metrology and Inspection
Sven Bauerdick, Philipp Weber, Klaus Gieb, Ulrich Hofmann, Marvin Zai and Roger McCay (GenISys GmbH)
Fabricating nano devices requires SEM imaging for routine calibration and critical structures, while conventional SEM tools cannot address the growing demand for automated metrology. We present an upgrade kit (InSPEC) providing advanced scanning, metrology, and data processing with direct integration to SEM hardware, all combined in a sophisticated software workflow.

9:00 am 3C5 Regular
Mitigating Challenges in Nanofabrication with Novel Electron and X-ray Microscopy
Sandip Basu (Carl Zeiss Microscopy)
This presentation explores Zeiss' innovative electron and 3D X-ray microscopy solutions for nanofabrication. High resolution scanning electron microscope performance along with novel hardware/software developments enable surface-sensitive microstructural and chemical characterization. The application of 3D X-ray microscopy highlights its potential for improved accuracy and efficiency in advanced device fabrication.

9:15 am 3C6 Regular
Unveiling the future of precise single ion implantation
Milos Hrabovsky, Jérémie Silvent, Anne Delobbe, Justine Renuad and Morgan Reveillard (ORSAY PHYSICS)
We are going to introduce a new dedicated single ion implantation tool, including an in-situ heating stage, and that can give access to a wide range of species for the implantation application with precise control of the vertical and lateral position of the implanted ion.

9:30 am 3C7 Regular
Advanced Nanopatterning With Cell Projection Electron Beam Lithography
John Whittey, Mathais Haedrich and Ines Stolberg (Vistec Electron Beam GmbH)
Electron beam lithography (EBL) can accomplish advanced and versatile nanopatterning, due to fine resolution and maskless writing. Vistec offers EBL systems for fast writing on different types of wafer and mask substrates. These systems are used for fabricating masks in mid-range technology nodes, fabrication of nanoimprint templates, and fast prototyping.

4A-Optical/EUV lithography and metrology

Room: Scripps Ballroom 1
Session Chairs: Patrick Naulleau (EUV Tech Inc.), Guy DeRose (California Institute of Technology)

10:20 am 4A1 Invited
Metrology driven data intelligence for research and productization of smart glasses and AR technology
Raja Muthinti (Meta Reality Labs)

10:50 am 4A2 Regular
Ultra-High Q-Factor Polymer Microring Resonators Fabricated by Two Types of Nanoimprinting Lithography
Wei-Kuan Lin, Shuai Liu, Sungho Lee, Zhesheng Zhang and L. Jay Guo (The University of Michigan Ann Arbor)
In this work, we present two different types of nanoimprinting lithography to fabricate polymer microring resonators. Based on both methods, we successfully show record levels of Q-factor photonic devices. We also present some unique properties of the nanoimprinted devices, such as residual layer-free and meniscus profiles.

11:10 am 4A3 Regular
Interferometric lithography on curved surfaces
Bruce Burckel and Mason Risley (Sandia National Laboratories)
We discuss interferometric lithography on curved surfaces and quantify the local radius of curvature limitations on achievable patterning pitch for a fixed illumination wavelength.

11:30 am 4A4 Regular
Single-exposure Millimeter-scale Volumetric Holographic Additive Manufacturing
Dajun X. Lin, Fei Yang Lyu, Apratim Majumder, Ji-Won Kim, Connor J. O'dea, Kwon Sang Lee, Michael Cullinan, Chih-Hao Chang, Zachariah A. Page and Rajesh Menon (University of Utah)
We demonstrate a single-exposure volumetric holographic additive manufacturing. The millimeter-scale 3D hollow cube can be simultaneously polymerized in UV resin within 1 second exposure time

11:50 am 4A5 Regular
Aperiodic Multilayer Mask Optimization for High-NA and Hyper-NA Extreme Ultraviolet Lithography – Reflectance, Polarization, and Phase
William E. Maguire and Bruce W. Smith (Rochester Institute of Technology)
As EUVL tools with higher image numerical apertures are introduced, the range of angles at the multilayer mask stack is also increased. We show that inclusion of phase and polarization optimization in aperiodic ML designs can extend 0.55 NA imaging to 14nm pitch, and 0.80 NA to 12nm pitch.

4B-Ion beam 1

Room: Scripps Ballroom 2

Session Chairs: Gregor Hlawacek (Helmholtz-Zentrum Dresden-Rossendorf), Frances Allen (Lawrence Berkeley National Laboratory)

10:20 am 4B1 Invited

Probing Radiation Effects in Gate-All-Around MOSFETs using Focused Particle Beams

Michael Titze, A. Belianinov, A. Tonigan, S. Su, G. Vizkelethy, W. Wampler, B. Hehr, M. Wang, H. Zhou, V. Narayanan, E. Bielejec, R. Arghavani (Sandia National Laboratories)

The Gate-All-Around (GAA) transistor architecture fundamentally changes the gate and isolation dielectric structures, with unknown impact on radiation performance. Additionally, GAA isolates the active device region from underlying silicon in a way that makes these transistors behave like silicon-on-insulator technology. In this work, we study GAA in surrogate radiation environments.

10:50 am 4B2 Regular

Microfabrication of cylindrical structures by proton beam writing for photonic nanojets formed in different media

Kunpisit Kosumsupamala, Nitipon Puttaraksa, Hironori Seki, Hiroyuki Nishikawa, Rikuto Hotta, Akihiro Tsuji and Tatsunosuke Matsui (Shibaura Institute of Technology)

PMMA microcylindrical structures were fabricated by the proton beam writing. The photonic nanojets were generated and characterized by the 532-nm confocal laser scanning microscope system. The profiles of photonic nanojets significantly varied with the optogeometric environment which are suitable for different applications.

11:10 am 4B3 Regular

Resist exposure with focused ion beams

Dan Read, Demis John, William Mitchell, Brian Thibeault, Torsten Richter, Achim Nadzeyka, Paul Mazarov, Fabian Meyer, Joel Fridmann and Yang Yu (University of California Santa Barbara)

Exposing resists with focused ion beams may have some advantages over electron beams, including little or no proximity effect. Here we present the details of exposing a variety of resists with a variety of light and heavy ions, including those produced by AuGeSi and GaBiLi liquid metal ion sources.

11:30 am 4B4 Regular

High-resolution imaging, nanofabrication and nanoscale analytics with light and heavy ions from a single source

Peter Gnauck, Torsten Richter, Alexander Ost, Achim Nadzeyka, Paul Mazarov, Lars Bruchhaus, Fabian Meyer, Olivier De Castro, Jean-Nicolas Audinot and Tom Wirtz (Raith GmbH)

In this presentation we will show different use cases of our liquid metal alloy ion source (LMAIS) based FIB platform in the field of ion imaging, nanofabrication, and nano analytics.

11:50 am 4B5 Regular

Recent Progress in Quantum Applications via the Q-One Single Ion Implantation System

G. Aresta, K. Stockbridge, K. McHardy, P. Blenkinsopp (Ionoptika Ltd.)

Recent development of the Ionoptika Q-One single ion implantation system in the filed of the quantum applications will be reported. Results obtained by the end users at Universities and Research Institute will be discussed together with update on the new systems development undergoing at Ionoptika.

4C-Chair's Special Session on Workforce Development in Semiconductors
Room: Grande Ballroom E
Session Chairs: Aimee Price (Ohio State University), Niels Wijnaendts(lab 14)

10:20 am 4C1 Invited
Workforce Challenges across the "Chips" Industry
Melinda N. Gomez (SEMI Foundation)
The semiconductor/microelectronics industry is seeing an unprecedented amount of domestic and private investment right now. With a focus on diversity and equity, the SEMI Foundation is working to build and expand short and long term programs to meet the growing talent gap.

10:50 am 4C2 Invited
Shaping the Future - Intel's Academic Collaborations
Sowmya Venkataramani (Intel Corporation)
This talk examines Intel's strategy for developing semiconductor talent through educational partnerships, training, and community engagement. It will showcase the Intel Semiconductor Education and Research Program's success in Ohio as a blueprint for building a skilled workforce in the industry.

11:20 am 4C3 Invited
Beyond the Basics: PUIs and the Advanced Training of Semiconductor Professionals
Nicole Pfiester (Rose-Hulman Institute of Technology)
The benefits of primarily undergraduate institution (PUI) environments for engineering students will be discussed, as well as specific ways that Rose-Hulman Institute of Technology has merged advanced training into the undergraduate curriculum and strategies for weaving relevant high-level skills into the curricula of any institution.

11:50 am 4C4 Invited
Workforce Development from DARPA Chief's Perspective
Sha-Chelle Devlin Manning (Chief, Commercial Strategy, DARPA)

5A-Nanoimprint lithography and scalable manufacturing
Room: Scripps Ballroom 1
Session Chairs: Stephen Chou (Princeton University), Stella Pang (City University of Hong Kong)

1:40 pm 5A1 Invited
Wet etch, dry etch, and now MacEtch
Xiuling Li (University of Texas at Austin)
Metal-assisted chemical etching (MacEtch) is an unorthodox semiconductor etching method, that defies the isotropic nature of chemical etch through local catalysis and carrier transport effect and enables site-controlled nanostructure fabrication with unprecedented aspect ratio without plasma related damage. This talk will discuss the mechanism and applications in aggressively scaled devices.

2:10 pm 5A2 Regular
Rose-petal surface fabricated by using moth-eye structure with micro-holes structure and UV nanoimprint
Kazuki Arai and Jun Taniguchi (Tokyo University of Science)
By adding micro-holes structure to the moth-eye structure, we were able to create a rose petal effect surface. This fabrication method can be used to fabricate various micro-shapes by changing the photomask, and in the future, we will also be able to form water droplet alignment patterns.

2:30 pm 5A3 Regular
The effect of the nanopore shape on resistive pulse sensing of mononucleotides in plastic dual in-plane nanopore sensors
Hooman Abdolvand, Junseo Choi and Sunggook Park (Louisiana State University)
Investigating the effect of nanopore geometric shapes in plastic dual-nanopore sensors on the RPS signals and identification of mononucleotides. How the pore shape affects the peak amplitude, dwell time, electrical noises of the RPS signals as well as the time-of-flight of the molecules through the nanochannels and resulting discrimination accuracy.

2:50 pm 5A4 Regular
Fabrication of Non-Biofouling Nanochannel Sensor in Dimethacrylate-Based UV Curable Polymers by UV-Nanoimprint Lithography (NIL)
Junseo Choi and Sunggook Park (Louisiana State University)
We demonstrate the use of di(meth)acrylate-based UV resin such as glycerol 1,3-diglycerolate diacrylate (GDM), epoxy ester 70PA, or 1,3-glyceryl dimethacrylate (GDD), each featuring varying hydroxyl group numbers, for nanochannel sensor development as a viable alternative to a poly(ethylene glycol) diacrylate (PEGDA).

3:10 pm 5A5 Regular
Wafer-Scale Fabrication of Ultra-Low Loss Si3N4 Photonic Integrated Chips through Nanoimprint Lithography
Shuai Liu, Wei-Kuan Lin, Yuheng Zhang, L. Jay Guo and Zheshen Zhang (University of Michigan)
Utilizing nanoimprint lithography and optimized a-Si/SiN hardmask RIE etching approach, we achieve robust and cost-effective wafer-scale fabrication of ultra-low loss SiN photonic integrated chips. Demonstrating intrinsic Q factors up to 15 Millions and efficient combs generation, our work marks the first realization of high-Q SiN PICs via NIL.

5B-Ion beam 2
Room: Scripps Ballroom 2
Session Chairs: Shida Tan (Intel), Katja Hoeflich (Ferdinand-Braun-Institut (FBH) Leibniz-Institut fuer Hoechstfrequenztechnik)

1:40 pm 5B1 Invited
Nanofabrication of High-Transition-Temperature Superconductive Electronics with Focused Helium Ion Irradiation
Shane Cybart (University of California, Riverside)
We utilize helium FIB for the direct patterning of superconducting materials for nanoelectronics. The ion beam induces nanoscale disorder into the crystalline structure which converts the properties of the material from superconductor to insulator. describe process details and highlight applications in quantum sensing, and ultra low-power digital electronics.

2:10 pm 5B2 Regular
Spatially-Resolved Ion Beam Induced Phase Transition and Defect Analysis in Gallium Oxide
Umutcan Bektas Maciej Oskar Liedke, Fabian Ganss, Nico Klingner, Rene Hübner, Gregor Hlawacek, Helmholtz-Zentrum Dresden-Rossendorf(Helmholtz-Zentrum Dresden-Rossendorf)
I will present recent results on the focused and broad ion beam induced conversion of beta Galliumoxide into gamma Galliumoxide. The resulting structures are analysed using EBSD, XRD, PALS and DP-VEPAS.

2:30 pm 5B3 Regular
High-Resolution FIB and SIMS with a Cesium Low Temperature Ion Source
Adam Steele, Andrew Schwarzkopf and Brenton Knuffman (NanoTech Corporation)
We present the latest results from focused ion beam and secondary ion mass spectrometry systems equipped with a Cs+ Low Temperature Ion Source (LoTIS)1. LoTIS provides a high-brightness beam which enhances the capabilities of modern FIB and SIMS systems.

2:50 pm 5B4 Regular
Focused Ion Beams from LMAIS for Surface Imaging, 3D Volume analysis, and SIMS
Torsten Richter, Alexander Ost and Peter Gnauck (Raith GmbH)
Liquid metal alloy ion source (LMAIS) technology has evolved with the GaBiLi source. This innovation enables 3D imaging without sample tilt using Li+ and Bi+ ions. VELION FIB-SEM featuring GaBiLi ion source is explored for 3D imaging, emphasizing the potential synergy with SIMS for comprehensive analytical surface information.

3:10 pm 5B5 Regular
Imaging of SARS-CoV-2 infected Vero E6 Cells by Helium Ion Microscopy
Natalie Frese, Patrick Schmerer, Martin Wortmann, Matthias Schürmann1, Matthias König, Michael Westphal, Friedemann Weber, Holger Sudhoff and Armin Gölzhäuser (Physics of Supramolecular Physics and Surfaces)
Helium Ion Microscopy (HIM) images of SARS-CoV-2 infected Vero E6 cells are presented. Interactions between cells and virus, as well as among virus particles, are imaged. The absence of a conductive coating allows a distinction between virus particles bound to the cell membrane and virus particles lying onto the membrane.

5C-Nanoelectronics
Room: Grande Ballroom E
Session Chairs: Qiangfei Xia (University of Massachusetts Amherst), Carla Perez-Martinez (University College London)

1:40 pm 5C1 Invited
Analog computing with high precision and programmability enabled by memristors
Joshua Yang (University of Southern California)
Analog computing typically has superior energy efficiency and high throughput, but limited precision and programmability. We introduce memristive field-programmable analog arrays (FPAAs) to improve its reconfigurability. We engineer memristor device with 11-bit precision and develop a novel architecture to achieve arbitrarily high precision for vector-matrix multiplications.

2:10 pm 5C2 Regular
Overcoming Challenges in Single-Electron Charge Detection of Nanoscale dipoles.
Mohammad Istiaque Rahaman, Richard Allen McManus Jr., Daniel Joseph Noronha, Gergo P. Szakmany, Alexei Orlov and Gregory L. Snider (University of Notre Dame)
Single charge detection in nanoscale objects is extremely important towards functional realization of charge qubits. Our study focuses on achieving single charge detection within a nanoscale single electron box, employing a Single Electron Transistor (SET). The detection results are further validated through comprehensive simulations of the underlying structure.

2:30 pm 5C3 Regular
Scalable Fabrication of Vertically Arranged Bi2Se3 Crossbar Arrays of Memristors towards Neuromorphic Control Applications
Seungjun Ki, Mingze Chen, Jisoo Kim and Xiaogan Liang (University of Michigan)
The study outlines a method using physical vapor deposition to selectively grow hexagonal Bi2Se3 nanosplates on Au-deposited bottom electrodes, preventing shorted nodes in large-area crossbar arrays. This scalable approach could guide the fabrication of memristive devices for artificial neural networks and neuromorphic sensory devices.

2:50 pm 5C4 Regular
In-house 20k memristor/CMOS monolithic integration and its statistical characterization
Imtiaz Hossen, William A. Borders, Brian D. Hoskins, Advait Madhavan, Shweta Joshi, Jabez J. McClelland and Gina C. Adam (The George Washington University)
Interest in memristor devices has seen a rapid rise in the past decade due to their electronic programmability, non-volatile storage with years-long retention and small footprint. This work demonstrates the high performance of monolithically-integrated memristors across a large population and the potential for development of larger arrays in the future.

3:10 pm 5C5 Invited
Low Symmetry Van der Waals Photonic Materials
Han Wang (University of Hong Kong)
I will discuss our work in studying the unique optical properties resulting from their low symmetry crystal lattice will be discussed. I will also discuss our work in studying the interesting mechanical properties of inorganic double helical crystal material SnIP, discovering its record low Young's modulus and high mechanical flexibility.

Thursday, May 30
4:30-6:00 pm
Panel Discussion
Fairway Ballroom

Nanomanufacturing in the AI Era.

Moderator:
Dr. Gina Adam (Associate Professor, George Washington University)

Panelists:
Dr. Khershed P. Cooper (Program Director, NSF)
Dr. Patrick Jungwirth (Research Computer Engineer, ARL)
Dr. Niels Wijnaendts van Resandt (Head of Business Development, LAB14 GmbH)
Dr. Alvin Loke (Senior Principal Engineer, INTEL)
Dr. Qiangfei Xia (Professor, University of Massachusetts)

Friday, May 31

6A-Advanced micro/nanolithography 2
Room: Scripps Ballroom 1
Session Chairs: Liz Dobisz (SLAC), Chao Wang (Arizona State University)

8:00 am 6A1 Invited
At-wavelength metrology and characterization enabling EUV scaling
Patrick Naulleau (EUV Tech Inc.)
The advancement of extreme ultraviolet (EUV) lithography relies on at-wavelength metrology to understand and control materials for mask and patterning, essential for reducing feature sizes. The presentation will address how phase characteristics in EUV are sensitive to material variations and thin-film interference, complicating the patterning process. Additionally, it explores the significant role of stochastic effects arising during mask manufacturing, which impact the wafer level, emphasizing the need for precise characterization to improve lithographic accuracy.

8:30 am 6A2 Regular
Direct fabrication of gratings on ridge laser structures using focused bismuth ion beams
Ben Salmond, Wyn Meredith, Michael Wale, Peter Smowton, Sam Shutts, Dan Read, Demis John, William Mitchell, Brian Thibeault, Torsten Richter, Achim Nadzeyka, Paul Mazarov, Fabian Meyer, Joel Fridmann and Yang Yu (Cardiff University)
Distributed feedback lasers are essential components in long range data communication systems. To create these devices a costly regrowth process that may increase defects is often required. Focused ion beams can be used to directly pattern laterally coupled grating structures, greatly simplifying the fabrication process and potentially improving performance.

8:50 am 6A3 Regular
Flow Analysis of 2-photon 3D Printing in situ Material Exchange
Pratyaksh Yemulwar, Man Ho Wong, Josua Zscheile, Fatemeh Rajabasadi and Robert Kirchner (HETEROMERGE GmbH)
We demonstrated the successful fabrication of a cuboidal structure using the MergeOne (HETEROMERGE) exchange system and examined the flow analysis using a 25x immersion fluorescence microscopy (ZEISS) system. The results of this work helped to understand the real-time exchange happening during the 2PP-based 3D printing process.

9:10 am 6A4 Regular
Reflow transfer: extending planar micro- and nanolithography to 3-dimensional substrates
Gary Zabow (National Institute of Standards and Technology)
Traditional micro- and nanolithographic approaches are limited to patterning hard, flat surfaces. This talk introduces a new transfer microprinting approach that uses cheap, water-soluble, reflowable materials to extend such patterning to arbitrary material substrates and to truly 3-dimensional microstructures that may include high curvatures and sharp edges [Science 378, (2022)].

9:30 am 6A5 Regular
Field-Emission Scanning Probe Lithography-Based Mix and Match Fabrication of Junctionless FETs
Taner Altinmakas, Mert Özden, Sina Zare Pakzad, Ivo Rangelow, Arda Deniz Yalcinkaya, Umut Kerimzade and B. Erdem Alaca (Koç University)
The purpose of this study is to fabricate a silicon nanowire (SiNW)-based junctionless field-effect transistor (JLFET) on a silicon-on-insulator substrate using field-emission scanning probe lithography (FE-SPL) followed by cryogenic reactive ion etching (RIE) and characterization of the device. A mix-and-match method is utilized containing both micro and nanoscale fabrication steps.

6B-Ion beam 3
Room: Scripps Ballroom 2
Session Chairs: Alex Belianinov (Sandia National Lab), Armin Gölzhäuser (Bielefeld University)

8:00 am 6B1 Invited
Harnessing Charged Particle Beams to Tailor Defects by Design
Frances Allen (UC Berkeley)
The helium ion microscope has emerged as a multifaceted instrument enabling a broad range of applications beyond imaging in which the finely focused helium ion beam is used for a variety of defect engineering, ion implantation, and nanofabrication tasks. This talk will focus on discussing the many defect engineering applications.

8:30 am 6B2 Regular
Roadmap for Focused Ion Beam Technologies
Katja Hoeflich, Gerhard Hobler, Frances Allen, Tom Wirtz, Gemma Rius and Gregor Hlawacek (Ferdinand-Braun-Institut gGmbH)
This roadmap document comprises a review of the current state-of-the-art of advanced focused ion beam (FIB) processing and technology followed by an outlook on required future developments curated by a diverse group of stakeholders.

8:50 am 6B3 Regular
FIB direct patterning of graphene islands for localizing GaN nanowires epitaxial growth
Dyhia Tamsaout, Jean René Coupdevylle, Lucas Labbé, Jean-Christophe Harmand, Maria Tchernycheva, Ali Madouri and Jacques F. Gierak (Centre de Nanosciences et de Nanotechnologies)
Nanowires (NW) are promising candidates for the development of flexible optoelectronic devices, such as LEDs. With this objective, we have investigated the epitaxial growth of GaN nanowires (NWs) on graphene substrates patterned directly with finely and swift focused ion beams.

9:10 am 6B4 Regular
A new tool to perform hot ion implantation for the creation of dense NV ensembles in diamond
Jérémie Silvent, Justine Renaud, Morgan Reveillard, Anne Delobbe, Midrel Ngandeu Ngambou, Ovidiu Brinza, Fabien Bénédic, Jocelyn Achard, Pauline Perrin, Ionut Gabriel Balasa, Alexey Tiranov, Philippe Goldner and Alexandre Tallaire (ORSAY PHYSICS)
Orsay Physics has developed a novel implantation tool utilizing different species for diamond substrate processing, crucial for creating efficient nitrogen-vacancy centers in quantum sensors. Precise ion implantation at 800° C significantly enhances NV photoluminescence emission, allowing higher ion fluences without crystal lattice damage, a key advancement for diamond-based quantum sensor performance.

9:30 am 6B5 Regular
Improving Diamond Color Center Yield via Ultraviolet Irradiation during High-Temperature Annealing
Coleman Burdette Cariker, Jacob Daniel Henshaw, Ed Salvatore Bielejec, Michael Titze, Andy Mounce, Yifan Yao and Andre Schleife (Sandia National Laboratories)
We implant silicon ions in a diamond sample, followed by an annealing procedure where half of the sample is exposed to UV LED irradiation. We then perform photoluminescence spectroscopy on the implant sites, testing recent theoretical calculations which suggest post-annealing under UV irradiation can increase the activation yield of SiV.

6C-Applications of nanofabrication 1
Room: Grande Ballroom E
Session Chairs: Xiaogan Liang (University of Michigan), Ke Du (UC Riverside)

8:00 am 6C1 Invited
An engineered platform to study the influence of nanotopography on endothelial cell organization
Shani Tcherner Elad, Rita Vilensky, Noa Ben-Asher, Eyal Zussman and Leeya Engel (Israel Institute of Technology)
Endothelial cells are exquisitely sensitive to ECM topography. We engineered nanopatterned ECM constructs compatible with high resolution electron microscopy by electrospinning aligned and randomly oriented ECM fibers on gold electron microscopy grids. These cell culture supports will enable investigation of the sensitivity of endothelial cells to changes in ECM topography.

8:30 am 6C2 Regular
Memristor-based Tunable Oscillator for Frequency Hopping Spread Spectrum Technology
Nishat Tasnim Hiramony, Sushmit Hossain, Zerui Liu, Jiacheng Ye, Zhexiang Tang, Ting-Hao Hsu, Hongming Zhang, Yunxiang Wang and Wei Wu (University of Southern California)
A memristor based tunable oscillator is proposed for FHSS technology. The pseudorandom signals from our PN sequence generator are fed into a digital system that maps each signal to a particular frequency from a look-up table. The digital system then controls the conductance of memristors generating signals with desired frequencies.

8:50 am 6C3 Regular
Sublayer Carbonation of Ni(111) Surfaces from the Boudouard Reaction: An STM Study
Fang Xu, Jennifer Sanchez and Kevin Sutherland (The University of Texas at San Antonio)
The initial growth of surface carbon on Ni(111) by the Boudouard reaction was studied by STM. The adsorbed C atoms on terraces are weakly bound and those on step-edges induce a reconstruction of the Ni surface to create four-fold coordinates that mediate further carbide formation.

9:10 am 6C4 Regular
Residual Stress in Sputtered Au-Cu Thin Films
Brent Edgerton, Jaron Vernal Moon, Yangliu Liu and Roseanne Warren (University of Utah)
Thin gold electrodes have been fabricated and characterized based on their stress, morphology, mechanics, and optics. The fabrication mode used is sputtering, which has the ability to alter the work function in the surface material, a finding of great import for energy applications.

9:30 am 6C5 Regular
A WSe2-MoS2 JFET with tunable polarity via back gate voltage control
Ting-Hao Hsu, Hefei Liu, Hongming Zhang, Han Wang and Wei Wu (University of Southern California)
This study utilizes van der Waals integration to create a high-quality p-n junction in a WSe2-MoS2 JFET. The MoS2 gate controls carrier concentration in the WSe2 channel, enabling polarity switching with a back gate. The device demonstrates low leakage current, offering flexibility for diverse circuit applications.

7A-Scalable micro/nanomanufacturing 1
Room: Scripps Ballroom 1
Session Chairs: Richard Silver (NIST), Scott Lewis (Caltech)

10:20 am 7A1 Invited
Nanoapatite Delivery Platform for Antiviral Therapies
Jessica Andriolo, Jack Skinner, Marisa L. Pedulla and M. Katie Hailer (Montana Technological University)
Iron-doped apatite nanoparticles are a patented antiviral that exhibits high activity against herpes simplex virus 1 and the human papillomavirus. A nanoapatite delivery vehicle enables safe delivery of the active ingredient to mammalian cells to prevent viral replication in a manner that enables use as a broad spectrum antiviral therapy.

10:50 am 7A2 Regular
Fabrication of FDTD-based inverse design enables f/0.27 flat microlens array for integral imaging
Tina M. Hayward, Apratim Majumder, Dajun X. Lin and Rajesh Menon (University of Utah)
We designed, fabricated, and characterized an ultra-low f/# (0.27) micro-MDL array with an extremely short focal length while preserving a large aperture to allow for easy integration onto security offset prints. We fabricated the master pattern (min. feature = 700nm) using grayscale lithography, which was replicated using UV casting.

11:10 am 7A3 Regular
Investigation of Capillary and Electrostatic Forces in Anti-Dust Nanostructures
Andrew N. Tunell, Lauren Micklow, Nichole Scott, Stephen Furst and Chih-Hao Chang (University of Texas at Austin)
Investigation of changes in anti-dust performance of nanostructured surfaces as a function of environmental humidity. Low and high humidities cause electrostatic and capillary forces to dominate respectively. We present the contribution of these forces across a range of humidities and investigate transparent surface coatings to tune the response.

11:30 am 7A4 Regular
Lead Halide Perovskite Pixel Arrays Fabricated by Ultrathin Reusable Metal Mask
Zhao Sun, Zhuofei Gan, Jianwen Zhong and Wen-Di Li (University of Hong Kong)
In this study, we propose a novel patterning process for perovskite arrays using a high-resolution, large-scale metal mask and spin-coating.

11:50 am 7A5 Regular
Fabrication of Memristive Network Devices on Nanomembranes
Mingze Chen, Xiaoqiu An and Xiaogan Liang (University of Michigan)
This work presents a novel nanomanufacturing method for fabricating Bi2Se3 memristive networks on nanomembranes, which could be further transferred onto flexible polymeric substrates.

7B-Metamaterials, metasurfaces, and meta-optics 2
Room: Scripps Ballroom 2
Session Chairs: Jay Guo (University of Michigan), Ming Lu (Brookhaven)

10:20 am 7B1 Invited
Structural colors: toward AI design and low-cost fabrication
Weijie Feng, Anwesha Saha, Taigao Ma, Haozhu Wang and L. Jay Guo (The University of Michigan, Ann Arbor)
Structural colors based on layered structures can be mass-produced and have been applied in industrial applications. Such structures can now be designed using machine learning algorithms. Environmental-friendly chrome-like coating can be designed this way and made by PVD process. Solution process was explored as low-cost alternative to make layered structures.

10:50 am 7B2 Regular
Implementation of Nanopillar Metasurfaces for the Sensitive Detection of Antibiotic Signatures
Jacob Thomas Waitkus, Ke Du, Shuai Feng, Theodore Ndukaife and Sui Yang (University of California at Riverside)
Fabrication of unique silicon nanopillars allows for production of intricate metasurface geometries, capable of producing a desirable double-peak reflectance spectrum for the sensitive and specific detection of bound analytes. The facile fabrication workflow coupled with an antibiotic-gold nanoparticle assay, allows for plasmonic detection in the presence of the antibiotic signatures.

11:10 am 7B3 Regular
Thin-Films for Metastructures, Meta-Optics, and Surface Nanofabrication
Dominic Bosomtwi, Neal Raney, Md Sakibul Islam, Aaron Holzer and Viktoriia Babicheva (University of New Mexico)
We analyze thin films, metastructures, and surfaces with multipolar coupling and bound states in the continuum, leading to strong and narrow resonances. We show that we can control nanostructure parameters and enable directional scattering from the metastructure. Improved quality of the thin film results in enhanced electronic and photonic functionalities.

11:30 am 7B4 Regular
Enabling Nanofabrication of a 1mm² Metalens in less than a Minute by innovative algorithmic EBL Patterning Strategies
Frank Nouvertne, Guido Piaszenski, Jana Münchenberger, Christoph Aulbach and Volker Boegli (Raith GmbH Dortmund)
By exploiting the algorithmic description of a metalens pattern and directly translating it into an EBL job with pixel stream generation "on the fly", the throughput for nanofabrication of a 1mm² metalens was enhanced by a factor of 10 resulting in a total patterning time of less than a minute.

11:50 am 7B5 Regular
The Grayscale Nanoassemble Fabrication and ultra-realistic imaging of Height Gradient Nanostructures
Ruhao Pan and Junjie Li (Institute of Physics, Chinese Academy of Sciences)
A grayscale nanoassemble fabrication method based on the e-beam lithography and atomic layer deposition is proposed with the capacity of individually controlling the height of high aspect nanostructures, which have been used in ultra-realistic imaging of both high-resolution grayscale and color pictures.

7C-Personalized healthcare and nanofluidics
Room: Grande Ballroom E
Session Chairs: Ke Du (UC Riverside), Frank Vollmer (University of Exeter)

10:20 am 7C1 Invited
iMOST (instant Mobile Self-Test) -- Intelligent Nanostructures Enabling Accurate, Broad, Instant, Mobile Health Self-Test
Stephen Y. Chou (Princeton University)
The talk will present a new test platform: iMOST™ (instant Mobile Self-Test), which uniquely uses intelligent nanostructures to achieve rapid sample preparation and enable accurate, instant, simple, low-cost, mobile health self-tests, hence overcoming the major barriers in tests in self-tests or and offering a solution to the unmet needs.

10:50 am 7C2 Regular
Nanoparticle-assisted, Portable Detection of African Swine Fever Infection
Seyedsina Mirjalili, Yeji Choi, Carmina Gallardo, Marisa Arias Neira and Chao Wang (Arizona State University)
We propose and demonstrate a novel nanoparticle-based, rapid, in-solution assay for ASF detection. This assay does not require washing, amplification, or labeling, lowering test costs. Our design concept introduces a novel signal transduction for antigen- and antibody-sensing, based on antigen-antibody binding induced metal nanoparticle aggregation and subsequent plasmonic color change.

11:10 am 7C3 Regular
Rapid, Electronic, and Accessible Detection of COVID-19
Yeji Choi, Seyedsina Mirjalili, Md Ashif Ikbal, Sean McClure and Chao Wang (Arizona State University)
Conventional diagnostics (PCR, ELISA) are slow and personnel-demanding; RATs have low sensitivity. We present a cost-effective, miniaturized system to detect SARS-CoV-2 antibodies/antigens from body fluids, achieving high sensitivity (aM), rapid results (15-30 min), and low cost (few dollars). Performance evaluation showed ultra-low LoD for antibody and antigen detection, outperforming ELISA.

11:30 am 7C4 Regular
Passage of Nasopharyngeal Carcinoma Cells through Narrow Channels
Xiao Hong, Yuanhao Xu and Stella Pang (City University of Hong Kong)
Microwells with connecting channels and nanoholes at the bottom were fabricated to investigate the passage of nasopharyngeal carcinoma cells. Traversing probability of cells through narrow channels decreased with nanoholes patterned at the bottom, which is correlated to the reduced cell motility caused by the F-Actin rearrangement.

12:00 pm 7C5 Invited
Nanoparticle-Supported, Rapid, Electronic Detecting System for Accessible Infectious Disease Diagnosis
Chao Wang (Arizona State University)
To address the need for highly sensitive yet accessible tests to curb infectious diseases, we propose and demonstrate a new approach, termed nanoparticle-supported, rapid electronic detection (NasRED), as a modular sensing platform with a high analytical sensitivity as low as atto-molar range for a variety of infectious antigens.

8A-Scalable micro/nanomanufacturing 2
Room: Scripps Ballroom 1
Session Chairs: Todd Hastings (University of Kentucky), James Spallas (KLA)

1:30 pm 8A1 Invited
Parallel Nanoscale 3D Printing with Nonlinear Initiation Depletion
Venkata Kalyan Vadlamudi, Shih Hsin Hsu, Jinwoo Kim, Teng Chi, Zihao Liang, Paul Somers, Bryan Boudouris, Xianfan Xu and Liang Pan (Purdue University)
We report parallel 3D nanoprinting based on a one-photon nonlinear photopolymerization process by controlling the depletion and diffusion processes. We demonstrated 120nm resolution by using a compact low-cost diode laser of milliwatt power at a scanning speed of 100s-1000s μm/s. We constructed a multiphysics model to understand the process.

2:00 pm 8A2 Regular
Full-Wafer Nanoimprint Patterning for CMOS Pilot Line Development and Manufacturing
Matt Traub, Myriam Willegems, Steve smout, Pau Guell I Grau, Silvia Lenci, Mohamed Saib, Eleonora Storace, Aurelie Humbert, Bogumila Kutrzeba Kotowska, Igor Turovets and Joey Hung (imec)
This talk presents on-going results on the incorporation of nanoimprint lithography (NIL) into a 300 mm CMOS pilot line, including handling of non-traditional glass substrates, high-selectivity etch processes, and full wafer metrology. The combination of large area NIL patterning with CMOS precision opens new possibilities for scalable nanofabrication.

2:20 pm 8A3 Regular
Automation of Pattern Driven Metrology for Photonic Devices Utilizing a FESEM for Process Monitoring
Chad Eichfeld, Bangzhi Liu, Michael Labella, Guy Lavallee, Marvin Zai, Klaus Gieb and Sven Bauerdick (Pennsylvania State University)
In this paper we present methods and results for utilizing our FESEM (Zeiss Gemini) to acquire pattern driven automated images in combination with measurements using an integrated software upgrade kit for metrology (GenISys InSPEC). A special focus is on photonic devices like large area gratings, photonic crystals, meta lenses, etc.
Xiaohui Tang, Meng Yu, Xiaoqun Fu, Chang Chen and Sijia Xie (Shanghai Industrial μTechnology Research Institute)
Addressable titanium nitride-based microelectrode array with the electrode density of 11 million sites/cm2 can be realized via our developed MEMS technological processes. The corresponding morphology and elemental distribution are examined through SEM and EDS analysis, respectively. Its potential in high-throughput parallel DNA synthesis is verified via Cy3-labelled phosphoramidite coupling experiments.

2:40 pm 8A4 Regular
Fabrication of Metallic Nanostructure Substrate by Templated Electrodeposition for Laser Desorption/Ionization Mass Spectrometry Detection
Chuwei Liang, Zhuofei Gan, Menghong Xu, Hongtao Feng and Wen-Di Li (The University of Hong Kong)
We report herein the use of metal nanopillar arrays fabricated by interference lithography and templated electrodeposition as the surface-assisted laser desorption ionization (SALDI) substrate for mass spectrometry (MS)-based small molecule profiling.

3:00 pm 8A5 Regular
Self-Aligned Fabrication of Vertical, Fin-Based Structures
Joshua A. Perozek and Tomás Palacios (Massachusetts Institute of Technology)
Modern power devices have realized 3-D, vertical designs offer many benefits for power density and reliability. However, fabrication techniques have historically relied on 2-D processes for lateral features. In this work, we present how multiple steps of angled depositions can be used for scalable, self-aligned fabrication of vertical, fin-based devices.

8B-Simulation, modeling, and design tools for nanofabrication
Room: Scripps Ballroom 2
Session Chairs: Liz Dobisz (SLAC), James Owen (Zyvex Labs)

1:30 pm 8B1 Regular
Characterizing profile tilt of nanoscale deep-etched gratings using Mueller matrix spectroscopic ellipsometry
Shiva Mudide, Nick Keller, Alexander R. Bruccoleri, Ralf K. Heilmann and Mark L. Schattenburg (Massachusetts Institute of Technology)
We introduce a fast, nondestructive optical method to measure tilt in high-efficiency, critical-angle transmission gratings for x-ray astronomy, using Mueller matrix spectroscopic ellipsometry. We ultimately aim to improve grating fabrication for telescopes, ensuring high diffraction efficiency and resolving power by optimizing the angle of incident x-rays.

1:50 pm 8B2 Regular
Closed-loop Simulation, Image processing and Data Preparation for Large Scale Structural Color Printing by EBL
Dengyang Lu and David S. Barth (University of Pennsylvania)
We introduce a closed-loop design method for printing large-scale, arbitrary color images with structural colors in metasurfaces. This involves FDTD simulation, RGB color mapping, image processing, and data preparation, allowing the easy fabrication of centimeter-scale color patterns in a fully programmatic process.

2:10 pm 8B3 Regular
Experimental and Numerical Analysis of Nanofluid Dynamics in Microchannels
Negin Bahadori and Yun Chen (Louisiana Tech University)
This study examines the use of nanotechnology in oil recovery, focusing on how silicon oxide nanoparticles in nanofluids affect oil mobilization in micromodels. Through experiments and simulations, we assess wettability changes and compare the performance of nanofluid with traditional methods, aiming to improve multi-phase flow dynamics in oil recovery.

2:30 pm 8B4 Regular
Dielectrics in the Boundary Element Method (BEM) solver of the General Particle Tracer (GPT) code
Sebastiaan van der Geer and Marieke de Loos (Pulsar Physics)
Here we present a new extension to the well-established GPT simulation code that allows isotropic dielectric materials to be included in the hierarchical Boundary Element Method (BEM) solver. The extensions allows particles to be tracked with nanometer precision through demanding electrostatic field configurations such as lens arrays.

2:50 pm 8B5 Regular
Multi-Photon Exposure Strategy and its Combination with Single-Photon Direct Laser Writing Technology
Benedikt Stender, Willi Mantei and Christian Pies (Heidelberg Instruments Mikrotechnik GmbH)
We will discuss TPP exposure strategies for topographies like microlens arrays and gearwheels. Combining TPP with UV direct laser writing demonstrates the compatibility with respect to application, materials as well as process steps and highlight the potential for innovative applications in fields ranging from micro-optics to micromechanics among others.

8C-Nanobiology, nanomedicine and implantable devices
Room: Grande Ballroom E
Session Chairs: Leeya Engel (Technion - Israel Inst. of Tech.), Natalya Kublik (Arizona State University)

1:30 pm 8C1 Invited
Nano- and micro-structured aptamer-field-effect transistors for implantable and wearable biomarker sensing
Anne Milasincic Andrews and Chuanzhen Zhao (University of California, Los Angeles)
We fabricate aptamer-coupled transistors on hard and soft materials. We produce multiplexed implantable and wearable sensing devices for animals and humans to improve understanding of behaviorally relevant information encoded by chemical modulators.

2:00 pm 8C2 Regular
Design, Fabrication and Test of a New Technology for MRI-Compatible Deep Brain Stimulation (DBS) Implants
Francesca Marturano, Aditya Tummala and Giorgio Bonmassar (Harvard Medical School)
Patients with deep brain stimulation (DBS) implants may face MRI safety issues. We propose a metamaterial-based technology for fabricating MRI-compatible DBS leads that reduces RF-induced current and Specific Absorption Rate. Preliminary experimental tests show that our wires present significantly lower tip heating at both 1.5T and 3T than standard wires.

2:20 pm 8C3 Regular
Rapid TNF-Alpha Quantification Using Gold Nanoparticles Towards Cytokine Monitoring in Inflammatory Diseases
Mohammad Altarfa, Maziyar Kalateh Mohammadi, Md Ashif Ikbal and Chao Wang (Arizona State University)
We propose an innovative approach making use of plasmonic gold nanoparticles (AuNPs) to rapidly and accurately quantify TNF-α in the presence of anti-TNF-α Abs and ADA to improve disease treatment efficacy.

2:40 pm 8C4 Regular
Merging Femtosecond Laser-based 3D Printing and Soft-lithography: a Hybrid Fabrication route for Organ-on-Chips
Gulden Akcay and Regina Luttge (Eindhoven University of Technology)
Organ-on-Chips (OoC) model organ function and their disease. These models often employ polydimethylsiloxane microfluidic architectures sealed with a flat microscope glass slide. We patterned fused silica as a sealing substrate utilizing 3D printing enabled by FEMTOprint to offer additional microfluidic capabilities for OoCs by this hybrid fabrication technique.

3:00 pm 8C5 Regular
From Lab to Field: Integrating Graphene Biosensors into Autonomous Systems for Real-Time Environmental Monitoring
Thomas Alava (CEA-LETI, Université de Grenoble Alpes)
Advancing graphene sensors from lab to field, we emphasize the importance of sensor integration into autonomous systems for effective on field operability. We will insist on strategic selection of biological target of interest, , and leveraging the advantages of relying on commercial SGFET technology, for enabling reliable sensing.
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9A-Resists and materials
Room: Scripps Ballroom 1
Session Chairs: Chih-Hao Chang (UT Austin), Jessica Andriolo (Montana Tech)

3:40 pm 9A1 Invited
Nanoscale layers of ferroelectric BaTiO3: From growth to fabrication
Jayakanth Ravichandran (University of Southern California)
BaTiO3 is a prototypical ferroelectric material with promise for memory and ferroelectric neuromorphic devices. Despite years of research, several outstanding challenges in the growth and fabrication of ultrathin nanoscale BaTiO3 layers remain. outline the advances achieved in my group to address these challenges.

4:10 pm 9A2 Regular
Hot on the trail of ultrathin films of patternable polyethylene
Sandra A. Gutierrez Razo, Andrew Madison, Daron Westly, Kalman B. Migler, Adam L. Pintar and Samuel M. Stavis (National Institute of Standards and Technology)
We are in hot pursuit of ultrathin films of low-density polyethylene (LDPE) that are sufficiently uniform for nanofabrication. We introduce a systematic study of hot spin-coating of LDPE films and develop an electron-beam lithography process to pattern LDPE nanostructures, enabling the creation of nanoplastic standards and other novel devices.

4:30 pm 9A3 Regular
STUDY OF TETRAETHYLAMMOMIUM HYDROXIDE AS AN ALTERNATIVE FOR TMAH DEVELOPER IN ELECTRON BEAM AND PHOTOLITHOGRAPHY
Kavya Dathathreya, Aimee Price, Justin Wirth, Chris Staudt and Dave Hollingshead (The Ohio State University)
Considering the dermal toxicity hazard of TMAH it would be desirable to find a less toxic metal-ion-free developer for photon and electron beam lithography (EBL). We compared developer based on the less toxic tetraethylammonium hydroxide (TEAH) to TMAH for broadband contact and direct write laser lithography and EBL.

4:50 pm 9A4 Regular
Exploring the use of Aberration-Corrected Electron-Beam Lithography with Novel Metal-Based Electron-Beam Resists
Fernando Camino, Nikhil Tiwale and Mohammad S. M. Saifullah (Brookhaven National Laboratory)
Recently, a low molecular mass metal-based resist produced patterns of the order of 4nm (approx. the probe size of the commercial e-beam writer used). Here, we present results on a novel negative-tone zinc-based resist patterned with a SEM and an aberration-corrected STEM, both equipped with a pattern generator.

5:10 pm 9A5 Regular
Enhanced contrast and high-resolution patterning of PMMA on insulating substrates under ambient gases
Deepak Kumar, Cooper Meyers, Robert Lewis Smith Jr. and Todd Hastings (University of Kentucky)
To our knowledge, these are the first studies of molecules other than water for EBL in gaseous environments. VP-EBL of PMMA under helium yields higher sensitivity, contrast (12.5) and the highest resolution (25-nm half-pitch dense lines and spaces) demonstrated to date for EBL on insulating substrates in a gaseous environment.
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9B-Nanophotonics and plasmonics 2
Room: Scripps Ballroom 2
Session Chairs: Abdoulaye Ndao (UCSD), Wei Wu (USC)

3:40 pm 9B1 Invited
Multi-dimensional Optical Field Manipulation Based on Dielectric Metasurfaces: Materials, Fabrication, and Applications
Cheng Zhang (Huazhong University of Science and Technology)
present a few of our recent works on multi-dimensional optical field manipulation based on dielectric metasurfaces

4:10 pm 9B2 Regular
Fabrication of A Nanodiamond Monolayer for Local Temperature Sensing of Plasmonic Gold Nanoparticles
Chengyuan Yang, Huirong Sun, Aliki Sofia Rotelli, Raphael Antonio Liboro Romasanta, Aaron Sean Zhenjie Tan, Steve Qing Yang Wu, Vignesh Suresh, Ee Jin Teo and Andrew Anthony Bettiol (National University of Singapore)
This work demonstrates a method of fabricating a nanodiamond monolayer on top of a layer of gold nanoparticles for localized thermal sensing and imaging of the gold nanoparticles under different conditions of optical excitation.

4:30 pm 9B3 Regular
Narrow linewidth surface lattice resonances in plasmonic aluminum nanoantenna arrays
Bhera Ram Tak, Kamonpan Chumpol, Robert O'Meara, Nebras Alattar and Richard G. Hobbs (Trinity College Dublin)
Plasmonic metal nanoparticles amplify optical fields, but suffer from low quality factor resonances. Surface lattice resonances (SLRs) in periodic arrays offer higher quality factors, crucial for applications like emitters and lasing. Here we report aluminum bowtie nanoantennas with narrow linewidth SLRs in the blue-green spectrum for potential strong coupling studies.

4:50 pm 9B4 Regular
Optical Microcavities: From sensing single molecules with WGM microlasers to applications in synthetic biology
Frank Vollmer (University of Exeter)
This talk discusses our latest results for whispering-gallery mode microcavities as biosensors, enhanced by plasmonic nanorods for single-molecule detection. It explores prospects in enzyme kinetics, thermo-optoplasmonic sensing, and single-molecule detection on microlasers, offering insights into biosensing advancements and applications in synthetic biology.

5:10 pm 9B5 Regular
Fabrication of spatially thickness-varying film by grayscale plasma etching
Shubin Huang, Zhao Sun, Zhuofei Gan, Jianwen Zhong, Zijie Jiang and Wen-Di Li (The University of HongKong)
In this work, a grayscale plasma etching is demonstrated to fabricate spatially thickness-varying layer with a nickel mask which is fabricated by a hybrid method. The layer thickness can be manipulated by changing the filling ratio of the pattern on the shadow mask.
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9C-Applications of nanofabrication 2
Room: Grande Ballroom E
Session Chairs: Rick Silver (NIST), Raja Muthinti (Meta)

3:40 pm 9C1 Invited
Hot Electrons and Integrated Photonics for Electron Emitters
Rehan Kapadia (University of Southern California)
we will discuss some of our recent work on how hot electrons and integrated photonics can be used to fabricate electron emitters with improved performance metrics.

4:10 pm 9C2 Regular
Memristor-based Analog Optimization Solver for Safety-critical Control
Sushmit Hossain, Ryan M. Bena, Zerui Liu, Buyun Chen, Pan Hu, Yunxiang Wang, Quan Nguyen and Wei Wu (University of Southern California)
A novel hybrid analog-digital architecture enhances safety-critical controllers in embedded systems, utilizing memristor-based analog computing for quadratic programming. This approach, applied in a micro-quadrotor UAV's flight control, significantly cuts processing times for collision avoidance, demonstrating the system's efficiency and effectiveness in real-world safety applications.

4:30 pm 9C3 Regular
Fabrication and Catalytic Performance of Electrospun HPA Supported in Pt-TiO2 Nanofibers for Hydrodeoxygenation
Amos Taiswa, Jessica Andriolo, Jack Skinner, Randy L. Maglinao and Sandeep Kumar (Montana Technological University)
Electrospinning is used to fabricate catalytic nanofiber scaffolds for biofuel conversion. The catalytic scaffolds produced were functionalized with TiO2 and Pt nanoparticles (NPs) and tungstosilicic acid crystals (Pt-TiO2-HPA). The performance was evaluated on a batch reactor using phenol as the feed. A 29% conversion and 100% benzene selectivity was recorded.

4:50 pm 9C4 Regular
Crossflow Electrospinning
Harold Pearson, Cody Baumstarck, Jessica Andriolo and Jack Skinner (Montana Technological University)
This abstract presents an adaptation of the handheld electrospinner to employ ionized air orthogonal to the direction of fiber creation to produce electrospun fibers. The crossflow ES system incorporates ionized airflow to direct nanofibers through the barrel with charged air, disrupting electrostatic forces accumulating at the walls of the apparatus.

5:10 pm 9C5 Regular
Decreasing Resistance of Aluminum based Single Electron Transistors as Quantum Charge Sensor
Runze Li, Pradeep Namboodiri, Nikki Ebadollahi and Joshua Pomeroy (National Institute of Standards and Technology)
Aluminum-based single electron transistors were fabricated under lower oxidation duration and with larger tunnel junction area. With the lower resistance we will get higher SNR and bandwidth from these devices which could then be integrated to quantum dot devices as charge sensors

Poster Presentations

Wednesday, May 30

Talk with Authors: 10:45 am – 1:00 pm, 5:45 pm – 7:00 pm

Thursday, June 1

Posters Available for Viewing

P1 Advanced micro/nanolithography

P1-1. Nanoscale Fabrication and Application Using Single GeV Ions

Author: Guanghua Du, Jinlong Guo, Hongjin Mou, Lei Zhang, Baobei Li and Linyan Fu

MeV to GeV ions deposit most of their energy within the radius of 1 nm around the ion trajectory. This report introduces the basics of GeV ion interaction with materials, and demonstrates the sub-5nm nanowire fabrication using in-air single ion lithography, nanofluidic fabrication and applications of a single-ion hit microbeam.

P1-2. 2.5D-Patterning of photonic structures by electron beam and i-line stepper based grayscale lithography processes

Author: Christian Helke, Sebastian Schermer, Susanne Hartmann, Jens Bonitz, Micha Haase, Eike Linn, Mathias Hädrich, Andy Zanzal, Patrick Reynolds, Stephen DeMoor, Anja Voigt and Danny Reuter

This paper showcases process developments that enable the fabrication of 2.5D structures using e-beam (VISTEC SB254, high resolution, low writing speed) and i-line wafer stepper (NIKON NSR2205i11D, medium resolution, high writing speed) grayscale based lithography processes for various applications such as micro lenses, photonic integrated structures, and MEMS-structures

P1-3. Progress on an Intra-Level Mix-and-Match approach of the chemically amplified positive-tone photoresist AR-P 7200.1 series for EBL and i-line stepper lithography

Author: Markus Gottwald, Susanne Hartmann, Christian Helke, Mandy Sendel, Harry Biller, Matthias Schirmer and Danny Reuter

The preliminary results of ongoing characterization of a novel chemically amplified positive tone resist AR-P 7200.1/1.n for Intra-Level Mix-and-Match lithography are presented. With this, processing steps and time can be saved while still providing the ability to image patterns with different dimensions via two lithography methods (EBL and i-line).

P1-4. Semiconductor Traceability: Die Annotations Patterning by Maskless Exposure Technology

Author: Garrett Oakes, Ksenija Varga, Thomas Uhrmann, Roman Holly, Tobias Zenger, Andreas Spitzer and Frank Bögelsack

The semiconductor traceability is becoming an important subject. The newly developed software "dynamic die annotation" feature represents a novel method for the applications in advanced packaging. By applying high resolution dielectrics, the patterned DataMatrix codes down to 200µm × 200 µm were resolved by maskless exposure technology.

P1-5. Multiplexed Bioreceptors NanoPatterning Using Thermal Scanning Probe Lithography

Author: Hashem Nasralla, Alexander Wright, Rahul Deshmukh, Davood Shahrjerdi and Elisa Riedo

Surface functionalization is a method of introducing chemicals and bio-materials for detection and conjugation. In this work, we study a method that allows for multiple materials to be locally functionalized to a surface without the need for barriers that enable spacial selectivity.

P2 Directed self-assembly

P2-1. Tip-Induced Nanopatterned Polymer Brushes for Directed Self-Assembly of Polymer Blends and Transfer into Silicon Structures

Author: Stefan Walheim, Roland Groeger, Tobias Heiler and Thomas Schimmel

Directed self-assembly of polymer blends and transfer into silicon structures is achieved using a structured polymer brush, which acts as molecularly thin sliding layer, enabling a 5000-fold increase in tip lifetime compared to bare silicon. Brush molecules bind weakly enough, that they can be reliably removed (20 nm line width).

P2-2. Influence of Thickness of PS-PMMA Block Copolymers on the Pattern Formation of Directed Self-Assembly

Author: Xiaolei Tong, Mohit Patel, Pat Watson and Gyuseok Kim

The influence of the thickness of PS (46.1k)-b-PMMA(21k) block copolymer on the formation of DSA patterns was investigated. Results show 1% BCP solution in toluene forms DSA patterns when the width of the trench is between 80 nm and 200 nm. We also demonstrate a 1-hr chemical process.

P2-3. Unusual Nanostructuring and Morphology-tuning by FIB: Self-Organization, Self-Assembly and Site-Specific Defect Engineering on the Functional Surfaces

Author: Bhaveshkumar Kamaliya, Raviej Uppu, Nabil Bassim and Thomas Folland

Here, we present self-organization and self-assembly attempts on metamaterial, 2D van der Waals materials such as hexagonal Boron Nitride (hBN) and Molybdenum Trioxide (MoO3) using Plasma Focused Ion Beam. We can self assemble and implat defect in hBN, while causing MoO3 to fold into interesting structures using kirigami techniques.

P3 Electron and ion beam lithography

P3-1. Thermal Analysis with High Accuracy of Multi-beam Aperture

Author: Yanjun Zhang and Zhuming Liu

The thermal effect of the electron beams on aperture was simulated with a finite element numerical method. A thermal-mechanical coupling model was used to analyze the stress field of the aperture.

The aperture deformation caused by thermal field and stress field under different cooling methods is compared.

P3-3. Nanowire Field Emitters Fabricated Using Helium Ion Microscopy Methods

Author: Ewelina Gacka, Krzysztof Kwoka, Tomasz Piasecki, Bartosz Pruchnik, Teodor Gotszalk, Gregor Hlawacek, René Hübner, Andrzej Sierakowski and Paweł Janus

The presentation will demonstrate the technology for depositing tungsten nanowire field emitters on microelectromechanical systems (MEMS). The helium focused ion beam induced deposition process will be applied. The field emitters will be electrically characterised and tested as a sensor to study the deflection of MEMS.

P3-4. Plasma focused ion beam species effects in cross-sectional metrology of EBL resist sidewall profiles

Author: Bernadeta R. Srijanto and Steven J. Randolph

Electron beam resist sidewall profiles play an important role in device fabrication. Here we report results from cross-sectioning studies of exposed e-beam resists using different ion species for coarse milling and polishing to determine the effects of ion species on cut face quality, pattern fidelity, and resist damage/distortion.

P3-5. Effects of Lithographic and Pattern Parameters on Stability of Feature-Edge Location in Electron Beam Lithography
Author: Soo-Young Lee
The non-ideal lithographic process such as the stochastic variation in exposure, developing time, etc. can lead to a deviation of feature-edge location. A closed-form mathematical expression of the deviation caused by such variation is derived in terms of lithographic and pattern parameters, to analyze the stability of edge location.

P3-6. Magnetic coupling between single-domain nanomagnets fabricated by focused electron beam induced deposition
Author: Heinz Wanzenboeck
Direct write deposition by focused electron beam induced deposition allows to fabricate 3-dimensional nanomagnets. Due to the geometric anisotropy and the small size such nanomagnets consist of only one single magnetic domain. In this study we quantify the coupling between magnetic stray fields of these nanomagnets and discuss potential applications.

P3-7. A Wien filter to separate beams of ionic liquid ions
Author: Alex Storey, Aydin Sabouri, Usama Ahmed and Carla Perez Martinez
Ionic Liquid Ion Sources (ILIS) are needle devices that produce beam of ions from ionic liquids. ILIS can be applied to a variety of techniques, including patterning and lithography. A Wien filter is implemented experimentally to filter the polydisperse beam and investigate the etching characteristics of the filtered beam.

P3-8. Buried nanochannels and texturized surfaces fabricated by focused helium ion implantation
Author: Sherry Mo, Dana O. Byrne and Frances I. Allen
Helium ion irradiation of bulk silicon can result in near surface damage and swelling due to helium implantation. Here we leverage this effect using a focused helium ion beam microscope to enable single-step, nanoprecise, and highly reproducible substrate texturing and subsurface channel formation.

P3-9. Accurate Endpoint Detection for Ion Beam Nanohole Milling
Author: Symphony Hsiao-Yuan Huang
A focussed helium ion microscope (Zeiss Nanofab), equipped with a digital camera, was used to demonstrate accurate process control and spatial endpoint detection during ion beam milling of nanoholes in various free-standing membrane materials, including crystalline and amorphous silicon (15 to 50 nm thick).

P4 Scanning probes techniques

P4-1. Electro-liquefaction of Cr Thin Films for Application in Scanning Probe Lithography
Author: Swapnendu Ghosh and Santanu Talukder
Electric field-induced oxidation of chromium film results in the formation of a liquid oxide. The oxidation process, which is usually rapid, can be tuned with the help of various parameters. This has led to the development of the scanning probe-based electrolithography technique, with which nanoscale features have been obtained.

P4-2. Correlative AFM-SEM Platform Enabling Unique Characterization of Samples
Author: Hamed Alemansour, Jost Diederichs, Sam Mitchell, Afshin Alipour, William Neils, Jeff Gardiner, Stefano Spagna, Chris Schwalb, Hajo Frerichs, Lukas Stühn and Marion Wolff
We present AFSEM, an AFM designed for integration into an SEM. AFSEM has a small size that is highly integrable with most SEMs/FIBs. We also have developed an interface unit to drive AFSEM. Finally, we will present our tilt rotation stage that can also be integrated inside an SEM.

P4-3. Identification of BClx Fragments on Si(100) Surfaces During APAM Processing Through a Combined STM/DFT Approach

Author: Jeffrey A. Ivie, Quinn Campbell, Shashank Misra, Azadeh Farzaneh and Robert E. Butera

We use a combined density functional theory and STM approach to help identify BClx (x = 0, 1, 2, 3) decomposition fragments on a sub-monolayer BCl3 dosed Si(100) surface. Establishing a relationship between DFT predictions and fragments observed in STM will help develop automated identification platforms for STM images.

P5 Nanoimprint lithography

P5-1. Soft and hard trimming techniques of imprint resists to fabricate silicon nanodisk arrays with different circularity

Author: Naoki Takano, Hiromasa Niinomi, Tomoya Oshikiri and Masaru Nakagawa

Precise control of edge and side-wall roughness of nanostructures is necessary because the roughness can be acted as an optical loss layer. In this study, soft trimming by UV/O3 and hard trimming by oxygen reactive ion etching were performed to control the shapes of imprint resist masks and silicon nanodisks.

P5-2. Fabrication of Polymer Optical Waveguides using Imprint Technology and Roll Press Coating

Author: Chishu Mori, Joji Maeda, Fumi Nakamura, Kenta Suzuki, Taro Itatani and Takeru Amano

Polymer optical waveguides are key components as optical links in co-packaged optics. We demonstrated waveguides fabrication using imprint technology in two ways and evaluated their beam profiles. By combining imprint technology with roll press coating, a waveguide without notable residual layer was obtained, and its horizontal beamwidth was 8.3 µm.

P5-3. Similarity effect of polymerizable functional groups of monomers and adhesive agents on liquid advancement in UV nanoimprinting

Author: Ryota Inagawa, Akiko Onuma, Hiromasa Niinomi, Tomoya Oshikiri and Masaru Nakagawa

To understand an increase in shear stress at nanogap, we study liquid advancement of UV-curable droplets by pressing them with a flat mold surface. A similar acrylate-type surface modifier on a silicon surface could promote liquid advancement of methacrylate-containing monomers better than an identical methacrylate-type surface modifier.

P5-4. Affordable Homemade Lab-scale UV Imprinting Device

Author: Tzu-Yu Huang, Hsiang-Yu Liao and Hung-Yin Tsai

A low-cost UV imprinting device has been developed using a digital force gauge and a height-adjustable stage. A floating joint is added, which decreases the residual layer thickness variation from 83.1 to 7.3 µm. The device can be mounted on a 3-axis gantry to fabricate large-area samples employing stitching imprinting.

P6 Scalable micro/nanomanufacturing

P6-1. High Resolution 3D Printing of Copper with Tunable Porosity Through µCLIP and Nanoporous Copper Powders

Natalya Kublik, Luyang Liu, Xiangfan Chen, Bruno Azeredo (Arizona State University)

In this study, we overcome the low-resolution and low-speed barriers in 3D printing both solids and porous metal structures in the micro-scale by combining Micro-Continuous Liquid Interface Production (µCLIP) with nanoporous copper powders (np-Cu) that present nanosized dependent optical and thermal properties.

P6-2. Vertical Trench Etching by Repetitive Dry and Wet Anisotropic Etching and 3D Self-aligned Sidewall Nano-patterning

Author: Yasser Pordeli, Céline Steenge, Andrea Migliorini, Erwin J.W. Berenschot, Ray J.E. Hueting, Stuart S.P. Parkin and Niels R. Tas

We introduce a wafer-scale fabrication platform for 3D silicon nanomachining using crystallographic nanolithography combined with dry and wet etching. Vertically stacked wedge type structures are created followed by local sidewall nanopatterning to form diamond-like cavities featuring sharp corners and edges which can serve as templates for self-aligned device fabrication.

P6-3. Assessing Feasibility of Nanoporous Copper Powders and Hybrid Feedstocks with Copper Nanoparticles for Laser Powder Bed Fusion

Author: Laura Duenas Gonzalez, Natalya Kublik and Bruno Azeredo

The integration of Nano-porous metals into Additive Manufacturing is generating interest for its ability to construct intricate structures. Nano-porous copper powders offer reduced reflectivity and lower sintering temperatures, promising energy-efficient printing. This study examines the flow, spread, and homogeneity of np-Cu powders and hybrid feedstocks for Laser Powder Bed Fusion.

P6-4. Scalable fabrication approach for single pixel microlens arrays

Author: Jens Bonitz, Christian Helke, Nils Dittmar, Sebastian Schermer, Micha Haase, Lutz Hofmann and Danny Reuter

A fabrication approach for microlens arrays based on i-line stepper lithography, thermal reflow and reactive ion etching is presented, representing a high throughput technology. Focus is on a high fill factor achieved by reducing the lens gap below the stepper resolution limit by optimizing each single process step.

P6-5. Portable Electrospinning for Orthopedic Wound Treatment

Author: Cody Baumstarck, Harold Pearson, Jakob T. Nielsen, Jessica Andriolo and Jack Skinner

Incorporating ionized air flow to a portable electrospinning device shows improvement to reliability in unfavorable environmental conditions. Antibacterial bandages will be deposited by this device and efficacy will be monitored on simulated orthopedic wounds in agar.

P6-6. 3D Printing of Microstructured Metallic Thin-Films

Author: Jiawei Zuo, Scott Clemens, ABDULLA AL Mamun, Dongyao Wang, Chao Wang and Yu Yao

We have produced complex thin metallic film structures using additive manufacturing from metal salts. These films are produced in nanometer range thickness and micrometer - millimeter range area.

P7 Simulation, modeling, and design tools for nanofabrication

P7-1. Simulation of "Spectral Ghosts" Generated by Imperfectly Fabricated Diffraction Gratings

Author: Cecilia R. Fasano, Casey T. DeRoo, Keri Hoadley, Edwin F. Cruz Aguirre, Jared Allen Brown Termini, Fabien Grise, Jake McCoy and Randall McEntaffer

We report on efforts to simulate "ghost" features of spectra generated by imperfectly fabricated, large-area diffraction gratings for use in ultraviolet astronomy. This simulation enables an iterative process for exploring critical tolerances of EBL feature placement accuracy when designing and patterning gratings with many write-fields.

P7-2. A Simulation Study of Proximity Effects in the CD SEM

Author: Delong Chen, Yanjun Zhang and Zhuming Liu

In this study, Nebula Monte Carlo electron simulator has been used to investigate proximity effects for varying primary electron beam landing energy, aspect ratio, spot size, top-rounding and bottom corner footing. Modeling and simulation results show how proximity effects impact on signal intensities, measurement accuracy and the corresponding sensitivities.

P7-3. Mechanical Modeling of Polymeric Stamp During Large-Area Electrochemical Metal-Assisted Chemical Imprinting

Author: Emmanuel Dasinor, Bruno Azeredo and Aliaksandr Sharstniou

Recent advancements in semiconductors using the electrochemical Metal-assisted Chemical Imprinting (Mac-Imprint) technique introduced a novel flexible stamp, enabling conformal micromachining on both planner and non-planar semiconductor substrates. The paper computationally analyzes the mechanical stability of the stamp, interfacial stresses, and strains during pressurization, providing simulation-based guidance for optimizing Mac-Imprint parameters.

P7-4. Investigation of Contrast Degradation due to Varying Incident Angles in Phase-Shift Lithography
Kwon Sang Lee, Luis A. Aguirre, Barbara Groh, I-Te Chen, Dajun X. Lin, Rajesh Menon, Michael A. Cullinan and Chih-Hao Chang (University of Texas at Austin)
We study how various illumination angles affect phase-shift lithography's contrast. Initial results show that even small divergence creates significant impact on structure uniformity. We will further investigate with computational analysis and confirm with experiments using a colloidal nanosphere mask pattern.

P8 Metrology and inspection

P8-1. A Highly Integrated Correlative Microscopy Platform
Author: Kerim T. Arat, Afshin Alipour, Hamed Alemansour, Andreas Amann, Jost Diederichs, Luis Montes, Brent Colvin, Jeff Gardiner, William K. Niels, Stefano Spagna, Chris H. Schwalb, Hajo Frerichs, Sebastian Seibert, Lukas Stühn and Marion Wollf
FusionScope is the first truly integrated AFM and SEM that serves the emergent field of correlative microscopy. Combining these two microscopy techniques, in-situ, into a highly integrated platform opens seamless correlation at the nanoscale while simplifying experiment workflows for higher throughput.

P8-2. Mechanical Testing of Silicon and Sapphire Nanopillar Structures
Author: Mehmet Kepenekci, Kun-Chieh Chien and Chih-Hao Chang
We examine the effect of structure geometry, material properties, and depth dependence on the mechanical properties of periodic silicon and sapphire nanopillars, using nanoindentation. Preliminary measurements show there are three distinct deformation regimes, including large strain and ductile-like response in silicon, and an improvement in ductility in sapphire.

P8-3. Artificial Intelligence for SEM Imaging and Metrology
Author: Andras Vladar
AI is new, and may not be for immediate implementation, but it's clear that SEM imaging and measurements and the SEMs used in the IC industry will benefit from it. Examples of AI solutions for SEMs and the possibilities for the development of significantly improved SEMs will be presented.

P8-4. Towards Automated Defect Classification in Atomic-Resolution Images Via Image Augmentation
Author: Shashank Venkatesan, Michael Baldea and Michael A. Cullinan
A new feature engineering approach is presented for automated defect classification in periodic nanostructures using images from an Atomic Force Microscope. This approach exploits image transforms (gradient, threshold, equalization) and is designed for implementation inline in continuous nanomanufacturing. Augmenting original images with preprocessed images consistently improves defect classification accuracy.

P8-5. Wide-Field and High-Resolution Low-Voltage Scanning Electron Microscopy with Correction of Beam-Image-Shift-Induced Deflection Chromatic Aberration
Shun Kizawa, Daisuke Bizen, Kohei Suzuki, Shunsuke Mizutani, Ryota Watanabe, Yuji Kasai and Yuzuru Mizuhara(Hitachi High-Tech Corporation)
We've developed an LVSEM system that uses a Wien filter to correct the deflection chromatic aberration caused by the beam-image shift. This advances low-damage, large-area nanoscale analysis of beam-sensitive materials, as demonstrated by successful aberration correction over a 28μm × 28μm field of view without additional settling time.

P9 Resists and other lithographic materials

P9-1. Characterization of ZEP520A Resist Response at EUV Wavelength

Author: Ethan Fermin Flores, Saurav Mohanty, Andrew N. Tunell and Chih-Hao Chang

In this work we investigate the use of ZEP520A resist as a positive EUV photoresist. The goal of this work is to demonstrate the viability of using ZEP resist for developing EUV lithography systems and configurations.

P9-2. Enhanced Stability of Hydrogen Silsesquioxane (HSQ) through Stabilizer-Incorporated Variant

Author: Harry Biller, Maik Gerngroß, Mandy Sendel, Matthias Schirmer and Frank Heyroth

Allresist GmbH introduces Medusa 84 SiH, an innovative HSQ variant with a stabilizer to counteract degradation and extend its shelf life as a liquid e-beam resist. Accelerated aging tests at 40°C for 30 days showed a significant improvement in stability with only 0.25% stabilizer, eliminating the need for freezer storage.

P10 EIPBN 2024 Industrial Highlights

P-1. Q-learning algorithm for solving Traveling salesman problem

Author: Hmayak Mkhitaryan, Lusine Tumanyan, Irina Minasyan and Liparit Hovhannisyan

We explored Q-learning, a fundamental technique in reinforcement learning. The study delves into the core principles of Q-learning, emphasizing its role to make optimal decisions in dynamic environments.

P11 MEMS/NEMS and Micro/nanofluidics

P11-1. Simulation of Planar Microshutter Array for Multi-object Spectroscopy

Author: Jason Clark, Yingsong Han, Li Jiang, Naga S. Korivi and Huafeng Liu

A planar microshutter array (MSA) is described in which light is modulated at each shutter. An MSA can allow columnated light from selected objects of a multi-object image to pass through a prism or diffraction grating for spectrographic analysis.

P11-2. Surfactant-Driven water-oil droplets in Microfluidics for Water Purification

Kritik Saxena and Yun Chen (Louisiana Tech University)

This work is to provide an understanding of the behavior of oil droplets under the influence of PFAS surfactants. The setup will pave the way for micro-scale water treatment, contributing to the development of an efficient and cost-effective water treatment process.

P11-3. Live-Cell Analysis Devices (LCAD) for Delivery and Sampling of Biomolecules

Author: Liliana Stan

A presentation on a design, fabrication and functionality of a modular microfluidic chip, the live-cell analysis device (LCAD), in which the delivery and sampling functionalities are integrated in a single multilayer chip.

P11-4. Sapphire Supported Aluminum Nitride Nanopore towards Stable and Low-Noise Biomolecule Sensing

Author: ABDULLA AL Mamun, Pengkun Xia, Md. Ashiqur Rahman Laskar, Nimarpreet Kaur Bamrah and Chao Wang

Conventional solid-state nanopores an effective tool for biomolecule sensing, face challenges like capacitive noise and stability. This study explores sapphire-supported AlN membranes as SiN alternatives. Wafer-scale fabrication and translocation tests reveal superior stability, noise reduction, and enhanced signal-to-noise ratio during biomolecule sensing, highlighting the potential of AlN in nanopore devices.

P11-5. Device Fabrication for Optical Lever Measurement of Torsional Motion

Author: Tina M. Hayward, Dongchel Shin, Ethan Zentner, Brian Baker, Rajesh Menon and Vivishek Sudhir

In physics, there is a growing question: is gravity quantum? One proposed experiment requires the precise measurement of angular motion of a torsional oscillator. To this end, we were tasked with fabricating a thin silicon-nitride bridge with a silicon weight – or pillbox - in its center.

P11-6. Electrophysiologic recording of heart muscle cells on a microchip with 3-dimensional nanoelectrodes
Author: Heinz Wanzenboeck
We present a microelectrode array for recording of action potentials from human cardioids. The microchip features perpendicular nanopillar nanoelectrodes for improved signal recording of cardiomyocytes. We present the fabrication process of 3D nanoelectrodes and the integration of a microfluidic system on the chip to facilitate lon-term organoid culturing on chip.

P12 Nanoelectronics/ neuromorphic and quantum computing

P12-1. Direct writing of Liquid Metals for Printed Electronics
Author: Navid Hussain, Tongtong Fu, Gabriel Marques, Chittaranjan Das, Torsten Scherer, Uwe Bog, Lukas Berner, Irene Wacker, Rasmus R. Schröder, Jasmin Aghassi-Hagmann and Michael Hirtz
Liquid metals (LMs) exhibit exceptional electrical and thermal conductivity, making them ideal for stretchable electronics. Our innovative glass capillary-based direct-write method overcomes printing challenges, allowing the successful fabrication of fully printed devices, including 3D-printed Galinstan lines and functional electronic components, paving the way for flexible, wearable sensors and devices.

P12-2. Electrical switching behaviors in Two-demensional flake of BaTiS3
Author: Hongming Zhang, Nan Wang, Jiangbin Wu, Huandong Chen, Jian Zhao, Ting-Hao Hsu, Jayakanth Ravichandran, Han Wang and Wei Wu
Our study focuses on the electrical switching behavior in BaTiS3. In this work, we firstly observed two distinct phenomena—memristor-like and ferroelectric-like electrical switching in the same material. The presented results pave the way for innovative applications and further exploration of the potential of BaTiS3 in emerging electronic technologies.

P12-3. Nanoimprinting-induced strain engineering of MoS2-based field effect transistors fabricated by stencil lithography
Author: Jianwen Zhong, Han Li, Zhao Sun, Zhuofei Gan, Chuying Sun, Yi Wan, Lain-Jong Li and Wen-Di Li
We propose a non-vacuum fabrication of a nickel thin-film (a few micrometers thick) as a stencil mask to deposit metal electrodes on patterned dielectric substrates and to etch two dimensional materials as a channel without photoresist lithography.

P12-4. Nanopore Diameter Impact on DNA Methylation Detection Using Methyl Binding Domain Protein Tags
Author: Nimarpreet Kaur Bamrah, Radhika Vattikunta, Liangxiao Chen, Deeksha Satyabola and Chao Wang
Methylation of DNA leads to epigenetic modifications and early diagnosis is difficult. Our work use Methyl specific Binding Protein MBD2 to attach the methyl domain of DNA and then translocated through a nanopore. Dwell time and current blockage signals are analyzed from 6&11nm pore and results are compared.

P12-5. Superconducting Materials and Process Exploration for Quantum Devices
Author: Aidar Kemelbay, Arian Gashi, Ed Barnard, Shaul Aloni and Adam Schwartzberg
The performance of quantum devices depends on the quality of materials and interfaces, controlling which at every fabrication step is crucial. To address this, a cluster deposition and characterization system is presented that includes nanofabrication and characterization tools in an integrated vacuum system, strengthened by autonomous materials and process exploration.

P12-6. Comparing Josephson Junction Fabrication Techniques for Superconducting Qubits
Author: Bethany Niedzielski Huffman, Alexander Melville, Gregory Calusine, Michael Gingras, Hannah Stickler, Ali Sabbah, Felipe Contipelli, Duncan Miller, Jonilyn Yoder, William D. Oliver, Mollie Schwartz and Kyle Serniak
This talk will compare Dolan-bridge and bridge-free Manhattan processing techniques for Al/AlOx/Al Josephson junctions for use in superconducting qubits for quantum computing applications. Consideration will be given to overall uniformity and yield across junction sizes as well as device performance.

P12-7. Neural Networks Implemented on Memristive SoC chip for Prompt Detection of Heart Attack
Author: Zihan Wang, Daniel Wang Yang, Zerui Liu and Wei Wu
We proposed an innovative approach for prompt and accurate detection of heart attacks. Our design is characterized by low latency, high accuracy, and energy efficiency thanks to a lightweight multilayer perceptron (MLP) and its end-to-end execution on a memristor based SoC with ten 256x256 crossbar arrays and other necessary components.

P12-8. Atomic Scale Devices in Silicon Fabricated using Scanning Tunneling Microscopy
Author: Pradeep Namboodiri, Jonathan Wyrick, Fan Fei, Brian Courts, FNU Utsav and Rick Silver
Atomic scale devices consisting of phosphorous monolayers fabricated using scanning tunneling microscopy open possibilities of making novel quantum devices. This poster presentation include our efforts so far in integrating on-chip microwave transmission lines for on-chip oersted lines with the objective of observing spin rotations using magnetic resonance.

P12-9. Detection efficiency enhancement for deterministic single ion implantation
Author: Kristian Stockbridge, David Cox, Gianfranco Aresta, Roger Webb, Steven Clowes and Ben Murdin
The detection efficiency of single ion implant events when detecting secondary electrons is dependent on many factors. In this work, deterministic implant detection efficiency is measured for a range of ion species and energies into Si and SiO2 using an Ionoptika QOne implanter.

P13 Metamaterials, metasurfaces, and meta-optics
P13-1. 3D bidirectional deformation nanostructures by focused ion beam bidirectional origami method for multichannel chiral metasurface
Author: Ruhao Pan and Junjie Li
A focused ion beam bidirectional origami method is developed to fabricate 3D bidirectional deformation nanostructures in micro/nanoscale. And a multichannel chiral metasurface with circular dichroism of 0.78 in the midinfrared regime has been proposed with an array of bidirectional folded split ring resonator.
P13-2. Functional Two-Photon Multi-Materials 3D-Printing of Lateral Micro-Optics
Author: Fatemeh Rajabasadi, Man Ho Wong, Tanya Saxena, Josua Zscheile and Robert Kirchner
Our team presents an innovative concept using a printhead in the Nanoscribe two-photon polymerization device. This technology enables 3D printing of multi-material structures in a single operation. We've demonstrated the novel lateral printing of a microlens system, showcasing the future potential for optical integration into advanced platforms.

P13-4. Thin-Films for Metastructures, Meta-Optics, and Surface Nanofabrication
Author: Dominic Bosomtwi, Neal Raney, Md Sakibul Islam, Aaron Holzer and Viktoriia Babicheva
We analyze thin films, metastructures, and surfaces with multipolar coupling and bound states in the continuum, leading to strong and narrow resonances. We show that we can control nanostructure parameters and enable directional scattering from the metastructure. Improved quality of the thin film results in enhanced electronic and photonic functionalities.

P13-5. Optical Metasurface Fabricated Using 3-D Nanoimprint Lithography
Author: Jiacheng Ye, Yunxiang Wang, Zhexiang Tang, Zerui Liu, Hongming Zhang and Wei Wu
The article discusses the shift from single-layer to multilayer optical metasurface devices using nanoimprint lithography, enhancing efficiency and light distribution for applications like 3D imaging flash LiDAR systems.

P14 Bioinspired nanostructures and engineered surfaces

P14-1. Fabricating Sapphire Nanostructures by Near-Field Focusing of Ultrafast Laser

Kun-Chieh Chien, Joshua Cheung and Chih-Hao Chang (University of Texas at Austin)

Bio-inspired nanostructures, with unique properties, have garnered interest. Sapphire surfaces, due to their hardness and stability, present challenges. This study introduces near-field ultrafast laser focusing with dielectric microspheres, successfully creating dense sapphire nanostructures using smaller silica particles. Additional details, including further fabrication results, challenges, and limitations, will be presented.

P14-2. Flow Evaluation of Traditional and Electrospun Enhanced Filtration Media

Author: Luke J. Suttey, Sowmya Sudhakar, Jessica Andriolo, Dennis James Moritz, John J. Borkowski and Jack Skinner

This work demonstrated significant enhancement of polypropylene filtration media by addition of morphologically distinct electrospun polycaprolactone fibers, and an efficient and low-cost methodology to provide a preliminary NIOSH-like filtration efficiency and flow (breathing resistance) evaluation of filtration media.

P14-3. Fabrication of Microstructure Devices on Porous Nanolattice Films

Author: Nayoung Kim, Saurav Mohanty, Vijay Anirudh Premnath and Chih-Hao Chang

Little work exists on fabrication of microstructures such as micro electrodes and waveguides on nanolattice, which is challenging due to difference in length scale and multilayer processing on porous layer. Therefore, we have developed method to pattern microscale features onto porous nanolattice layer using shadow evaporation and colloidal phase lithography.

P14-4. Iridescent Structural Color from Ultra-low Refractive Index Aerogel as Optical Cavity Dielectric

Author: Jennie Paik, Wei-Jie Feng, Sean Clark, Hyeonwoo Kim and L. Jay Guo

Herein we report a novel ultra-low RI (1.06) aerogel dielectric in a super-iridescent optical cavity-based structural color capable of tracing a near-closed loop in CIE color space. By tuning the refractive index, thickness, and geometry of the aerogel layer, we can produce a wide range of vivid and super-iridescent colors.

P15 Flexible/Implantable devices and nanomedicine

P15-1. Fabrication of Implantable Microcoils for Ultra-Focal Stimulation of Neurons with Selectable Orientation

Author: Yizhe Zhang, Francesca Marturano, Egemen Bostan, Ilknur Ay, Giorgio Bonmassar and Jiangdong Deng

We report the fabrication of implantable microcoils for ultra-focal stimulation of neurons with selectable orientations. Using the prototype chip, we could observe the unilateral electromyographic response signal from the hindlimb of the rat upon imposing a brief micro-magnetic stimulation pulse on its sciatic nerves.

P15-2. Plasmonic imaging for single extracellular vesicle characterization

Author: Mohammad Sadman Mallick and Wei-Chuan Shih

We present ultra near-field index modulated PlAsmonic NanO-apeRture lAbel-free iMAging (PANORAMA) that addresses existing issues for both SPR and LSPR imaging techniques. We demonstrate the detection and counting of single 25 nm polystyrene nanoparticles and characterization of extracellular vesicles, an emerging cancer biomarker.

P16 Nanofabrication for energy applications

P16-1. Synergistic Approach for Efficient Water Harvesting using LiCl-PVA Hydrogel and Nanofiber membrane

Author: Donghee Kang and L. Jay Guo

Water absorption properties of LiCl in a PVA hydrogel are investigated. The hydrogel forms a sustainable structure through freeze-thawing. However, increased Li content hinder to forming the structure. Introducing a nanofiber membrane improves vapor sorption kinetics and reduces water saturation time, enhancing water collection from semi-arid air.

P16-2. Adhesion and Excitation Lifetime of Perovskites on Modified Substrates

Author: Xavier T. Vorhies, Jessica Andriolo, Erik M. Grumstrup, David F. Bahr, Joseph J. Thiebes, Emma K. Orcutt K. Orcutt and Jack Skinner

This work focuses on the analysis of the optical performance of perovskite microcrystals on TiO2 thin films and how that performance changes as a function of changing adhesion to the substrate material. Optical and materials characterization includes absorption data, TCSPC, SEM-EDS. Adhesion measurements made with modified scratch-mode test.