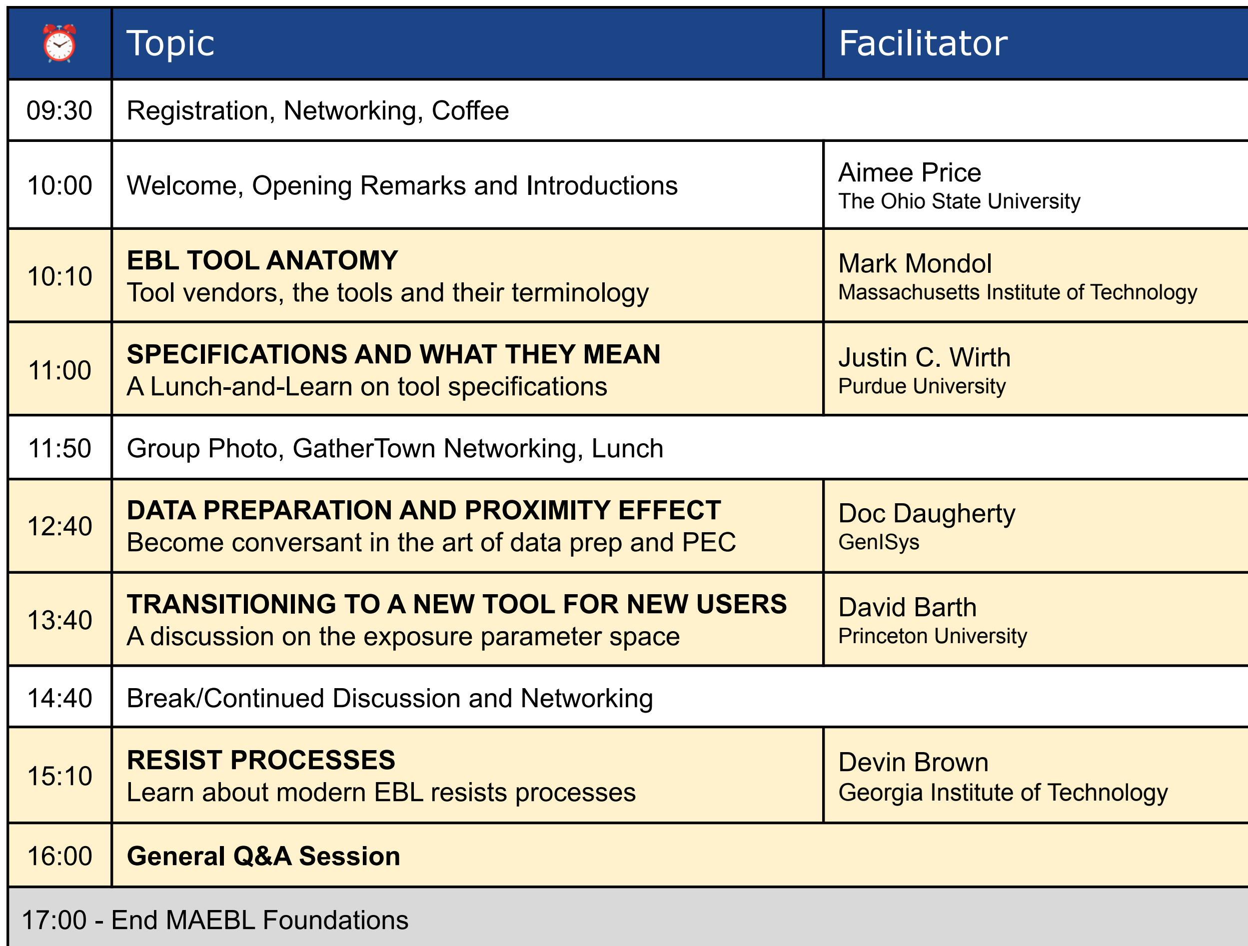
MAEBL
MID-ATLANTIC ELECTRON BEAM LITHOGRAPHY

University of Pennsylvania
Singh Center for Nanotechnology
3205 Walnut Street, Philadelphia, PA 19104
Tuesday-Wednesday, November 9-10, 2021

Session I: MAEBL Foundations Workshop*

Novice to advanced e-beam lithographers are invited to participate in Session I to learn, brush-up or help mentor others on the fundamentals of EBL. Advanced attendees are encouraged to impart personal accounts and challenges to the audience, elevating the workshop experience. At the end of the meeting beginners should be conversant in EBL and are encouraged to participate in Session II.



⏰	Topic	Facilitator
09:30	Registration, Networking, Coffee	
10:00	Welcome, Opening Remarks and Introductions	Aimee Price The Ohio State University
10:10	**EBL TOOL ANATOMY** Tool vendors, the tools and their terminology	Mark Mondol Massachusetts Institute of Technology
11:00	**SPECIFICATIONS AND WHAT THEY MEAN** A Lunch-and-Learn on tool specifications	Justin C. Wirth Purdue University
11:50	Group Photo, GatherTown Networking, Lunch	
12:40	**DATA PREPARATION AND PROXIMITY EFFECT** Become conversant in the art of data prep and PEC	Doc Daugherty GenISys
13:40	**TRANSITIONING TO A NEW TOOL FOR NEW USERS** A discussion on the exposure parameter space	David Barth Princeton University
14:40	Break/Continued Discussion and Networking	
15:10	**RESIST PROCESSES** Learn about modern EBL resists processes	Devin Brown Georgia Institute of Technology
16:00	**General Q&A Session**	
17:00 - End MAEBL Foundations		

*Program is subject to change without notice.

Charter Sponsors for The 2021 Meeting for Advanced Electron Beam Lithography

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Session II: MAEBL Core*

The core meeting is what started it all. Be part of the conversation and engage the collective knowledge of the electron beam lithography community.

⏰	Topic	Facilitator
08:30	Networking, Coffee and Light Breakfast	
09:30	Welcome, Opening Remarks and Announcements	
09:45	**Fabrication of a Custom Astronomical Grating for the Extreme Ultraviolet Bandpass**	Fabien Grise The Pennsylvania State University
10:30	**Resist Supply Chain**	Jeremy Golden General Manager, KemLab Inc.
11:15	Coffee Break/Continued Discussion and Networking	
11:30	**COMMON CHALLENGES I** An Open Forum Discussion of Common Issues ● Managing Small Substrates ● Anti-Charging Techniques ● Negative Resists	Mark Mondol and Guy DeRose Massachusetts Institute of Technology California Institute of Technology
12:30	GatherTown Networking, Lunch	
13:30	**TOOL TRAINING** A Discussion on User Training	Justin C. Wirth and Aimee Price Purdue University and The Ohio State University
14:15	**Resist Stacks and Pattern Prep for Undercut and Resist Profile Control**	David Barth Princeton University
15:00	Coffee Break/Continued Discussion and Networking	
15:15	**BEST PRACTICES IN PREVENTATIVE MAINTENANCE** Benchmarking and Servicing an EBL System	The MAEBL Community
16:15	**COMMON CHALLENGES II** Open Forum Discussion of Common Issues ● Pattern Generator ● Data Preparation ● Fracturing and Shape Filling	Gerald Lopez University of Pennsylvania
17:15	Closing Remarks - Continued Discussion and Networking	
18:00 - End Meeting		

*Program is subject to change without notice.

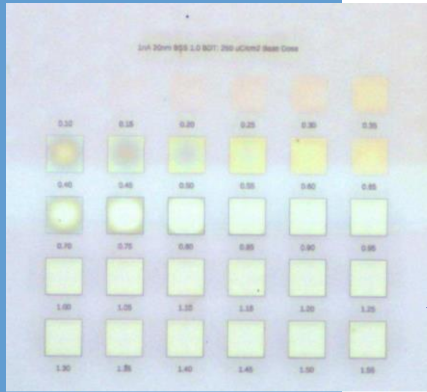
DisChem

CHEMISTRY FOR ADVANCED LITHOGRAPHY

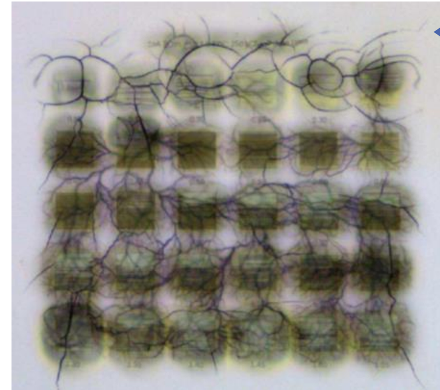
DisCharge H2O

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 40 nm conductive film. Available in three concentrations for wide process window.
- 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. No filtration required prior to use.



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



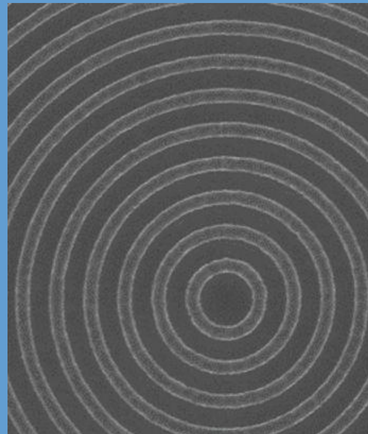
Without DisCharge: charge accumulation and sudden charge dissipation caused by exceeding the dielectric breakdown strength of the PDMS to the Si substrate resulting in significant image distortion in the resist and destruction of the PDMS surface.

anti-charging

H-SiQ *(hydrogen silesquioxane)*

NEGATIVE-TONE ELECTRON BEAM RESIST

DisChem H-SiQ is a negative tone hydrogen silesquioxane 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 film EBL applications.

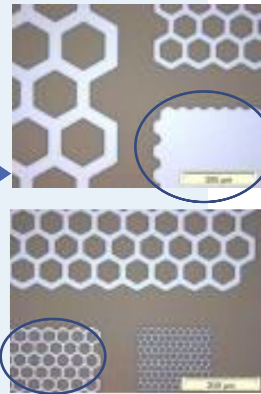


resist

SurPass

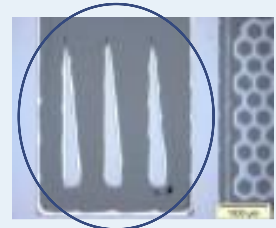
RESIST ADHESION PROMOTERS

- 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

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ALLRESIST

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Conductive Resist
Electra 92

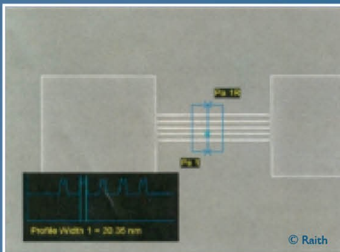
Charge dissipation, for Excellent nanostructures, top-layer for e-beam resists, easy removal with water.

Electra 92 on different e-beam rsists and insulating substrates:

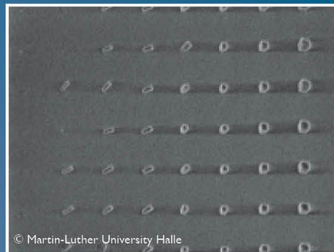
Positive E-Beam Resist
CSAR 62

High resolution, highly sensitive, excellent plasma etch resistance, improvement to ZEP-resists

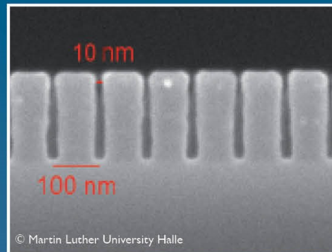
Excellent resolution at 10 nm
dose to clear: 10 µC/cm²
resist thickness: up to 1.5 µm



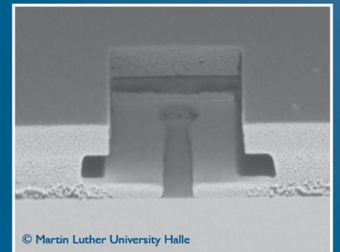
20 nm lines of HSQ, generated on quartz with Electra 92



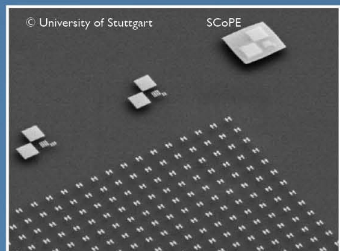
60 – 150 nm squares (height 100 nm) with AR-N 7700.08 / Electra 92 on glass



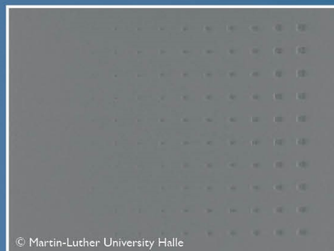
Spacing with an aspect ratio of 18; 10 nm resolution at a film thickness of 180 nm



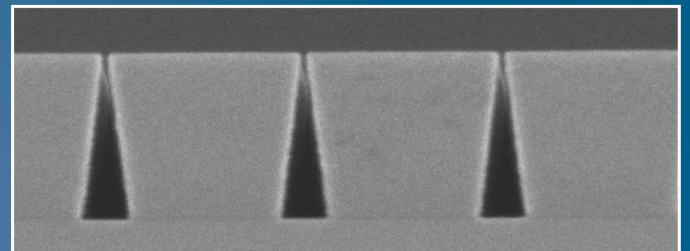
Well-defined 3D resist profile for a T-gate nanostructure with 950k PMMA (bottom) / AR-P 617 / CSAR 62



Strongly isolating polymer structures coated with Electra 92 in SEM



30 – 150 nm squares with CSAR 62 and Electra 92 on glass



Forming of lift-off structures with CSAR 62 at higher dose

www.allresist.com

ELS-BODEN

Electron Beam Lithography System

ELIONIX
Action for innovation

ELS-BODEN
Acceleration 100kV × Single autoloader

High Performance Capabilities for High Resolution and High Throughput Applications

Features

Inherits traditional Elionix technology to meet user's requirements:

- 150kV / 125kV acceleration voltages, if ultra-fine patterns are most important.
- 100kV for common applications and a wide variety of requirements.
- 50kV for high speed production.

Available in 200mm and 300mm chambers:

- The first full 300mm square writing area in the marketplace.
- Sample holders from small pieces commonly used in basic research to 2/3/4/5/6/8/12 inch wafers.
- Mask holders, such as for the 6025 and 9025 mask sizes, are also available.

Complete line of automatic loading systems:

- Single cassette autoloader, which is useful for research and development applications.
- Multiple cassette autoloader for small to medium volume production.
- Full lineup of robot loading systems

Specifications

Electron Gun	ZrO/W Thermal Field Emitter			
Acceleration voltage	50kV	100kV	125kV	150kV
Beam current	1nA ~ 1000nA	20pA ~ 100nA	5pA ~ 100nA	5pA ~ 100nA
Min. beam spot size	D5nm	D1.8nm	D1.7nm	D1.5nm
Writing field size	1000μm□	1000μm□	500μm□	500μm□
Min. / Max. Field size	Min 100μm square Max (Option) 3000μm square			
Scan clock	Max 200MHz			
Min. beam position	0.1nm (at standard field)			
Max. sample size	200mm wafer / 300mm wafer			
Max. writing area	200mm square / 300mm square			
Loading system	Single autoloader Multi autoloader 300mm FOUP robot loader PEB robot loader			
Software	elms Beam conditions Exposure schedule Pattern data converter Account management Python scripting			

ELIONIX, INC.
3-7-6 Motoyokoyama-cho Hachioji Tokyo 192-0063
Japan

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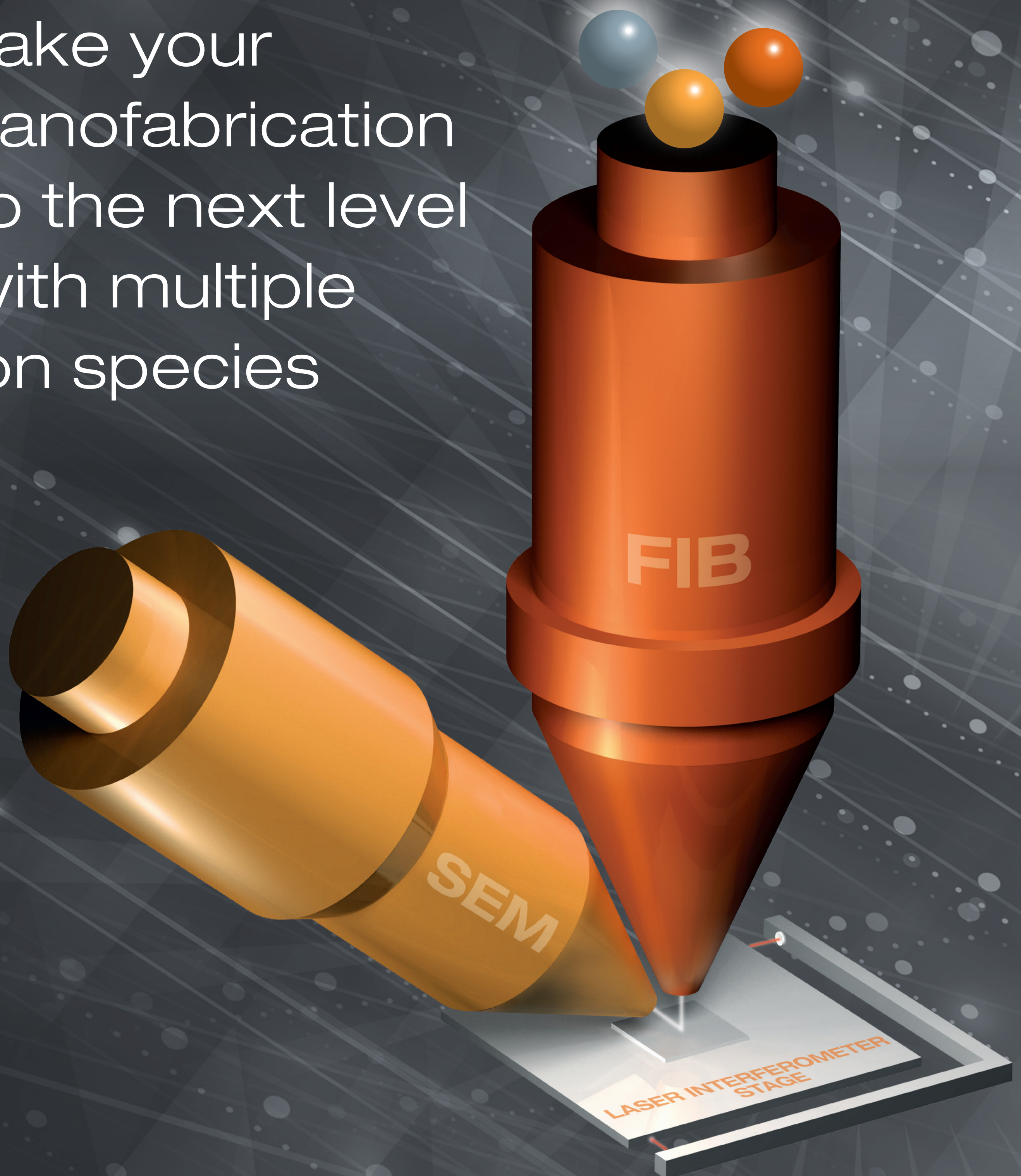
VELION



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RAITH
NANOFABRICATION

E-Beam Lithography
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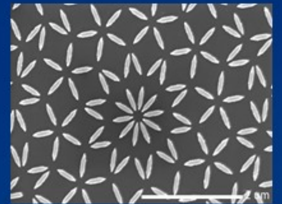
Since 1967

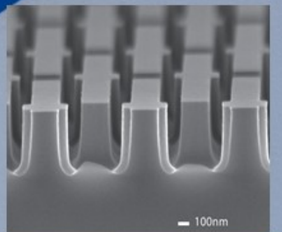
200kV
World's Highest
Accelerating Voltage

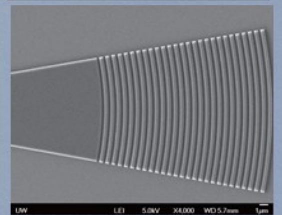
New GUI
Intuitive Interface

Direct to Cassette
No Alignment Station Needed

Height Sensor
Mapping SiC/GaN/Quartz
Since 2005







Registration helps to offset the operational costs of the meeting series. To qualify to attend, you must be an active EBL tool owner/user at a recognized academic, industry, or government lab and must sign up using your institution's email. To promote intimate dialogue, we have kindly requested that EBL hardware vendors refrain from registering. Advance online sign-up is required to participate. Thank you for your cooperation and understanding. A single registration is not for an organization; it is for an individual and is not transferrable.

ATTENDING IN PERSON

The health and safety of the MAEBL community is our primary concern. If you are attending in person, the University of Pennsylvania requires each attendee to be fully vaccinated and be ready to show proof of vaccination upon request. According to the Centers for Disease Control and Prevention, individuals are considered to be fully vaccinated:

- 2 weeks after their second dose in a 2-dose series, such as Pfizer or Moderna vaccine or
- 2 weeks after a single-dose vaccine, such as Johnson & Johnson.

All attendees will be required to wear a face covering. In the event of contact tracing, your contact information may be shared with the University or any other responsible entities. For more information about the University of Pennsylvania's COVID-19 policies, please review its Public Health Guidance.

PARKING

If street parking is not available, please park at the Chestnut 34 Garage whose location and rates can be found using the following link:
http://cms.business-services.upenn.edu/transportation/live-maps/parking-map.html

GETTING HERE

If you're arriving by plane into PHL, you can take the train to University City. Cabs are also available at the airport as well as UBER and Lyft. Car rentals are also available at the airport. If you're arriving by car, please refer to the parking information above. If you're arriving by train, the Singh Center for Nanotechnology is considered within walking distance from 30th Street Station. You can also take a cab, UBER , or Lyft from this location.

HOTELS

There are a few hotels in University City that are considered within walking distance to the Singh Center for Nanotechnology:

- Sheraton Philadelphia University City Hotel: 36th and Chestnut
- The Inn At Penn - A Hilton Hotel: 36th and Walnut
- Homewood Suites by Hilton: 41st and Walnut
- The Study At University City: 33rd and Chestnut

Alternatively, Center City has a few options near the Convention Center and the historic City Hall. If you stay at any Center City location listed below, take any trolley from 13th Street Station to 33rd St. Station

on Market Street or the westbound busses #21 or #42 along Walnut Street and walk to the Singh Center for Nanotechnology.

- Courtyard by Marriott Philadelphia Downtown
- Residence Inn by Marriott Philadelphia Center City
- Philadelphia Marriott Downtown
- Hilton Garden Inn Philadelphia Center City
- Home2Suites by Hilton Philadelphia

REFUND and REGISTRATION TRANSFER POLICY

No refunds will be issued.

Please be mindful that we are a non-profit organization operated by volunteers. A single registration is for an individual (not an organization) and is not transferable. Anyone wishing to attend must register under their own name. An attempt to transfer registration undermines our mission and capacity to organize meetings for the electron beam lithography community. Thank you for your cooperation and understanding of this matter.

PRIVACY POLICY

In the event of contact tracing, your contact information may be shared with the University or any other responsible entities. For all other purposes, your registration information will not be distributed without your consent.