

NNCI: The Mid-Atlantic Nanotechnology Hub (MANTH)



An NSF National Nanotechnology Coordinated Infrastructure Node

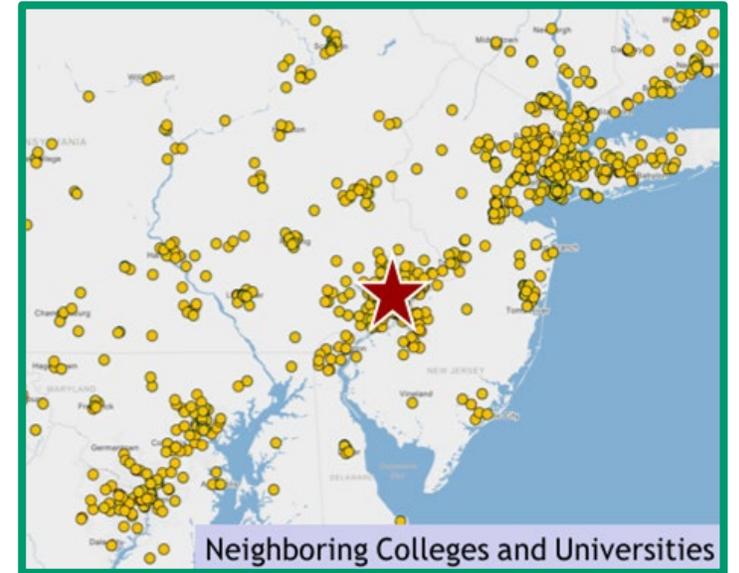
Singh Center for Nanotechnology, University of Pennsylvania; and Community College of Philadelphia

2022 NNCI Annual Meeting, Ithaca, NY

October 2022

About MANTH: Location, Purpose, and Mission

- The Mid-Atlantic Nanotechnology Hub (MANTH) of the NNCI is located in Philadelphia, at the center of the industry-dense and academically-rich Mid-Atlantic Region, and is anchored at MANTH partner **University of Pennsylvania's** Singh Center for Nanotechnology
- We are a **maker space for nanotechnologists** that enables exploitation of fundamental advances in nanoscience to realize nanotech materials, devices and systems
- Our center is comprised of **three core facilities and a staff of 13** with deep expertise in fabrication, process development, characterization, user interaction, and nano-related education
 - Quattrone Nanofabrication Facility (QNF), 10k ft²
 - Scanning and Local Probe Facility (SLPF), 5k ft²
 - Nanoscale Characterization Facility (NCF), 5k ft²
- MANTH partner **Community College of Philadelphia** has developed courses at the associates' level for budding nanotechnologists, and just completed a practical nanotechnology internship program for its students



Gerald Lopez
Associate Director



Pat Watson
Director,
User Programs



Kristin Field
Director,
Professional Development



Eric Johnston
Director, QNF



Doug Yates
Director, NCF



Matt Brukman
Director, SFP



Mid-Atlantic
Nanotechnology Hub



Community College of Philadelphia

MANTH continues to expand both its physical space and equipment base

- Quattrone Nanofabrication Facility

- A **New Process Bay** is being built out, bringing the total number of bays to 6. Project completion expected Summer 2023.
- An automated **TPT HB100 Wire Bonder** to support silicon quantum efforts has been ordered and will be housed in the newly constructed packaging lab.
- An NSF MRI-supported **Raith EBP65200 e-beam writer** has been purchased; expected installation end of CY 2022.



- Scanning and Local Probe Facility

- **Improved optics** on the Horiba Confocal Raman Microscope have been installed, including new linear and circular polarizers that control the excitation lasers, and stronger neutral density filters which allow very low levels of incident laser light for photoluminescence studies.
- A **heating stage** added to our MFP-3D systems. The polymer heating stage can reach 275C and is used to study additives in oils and lubricants.



- Nanoscale Characterization Facility

- A Gatan **ultralow temperature sample holder** (down to 7K) with electrical biasing has been added to our TEM facility.

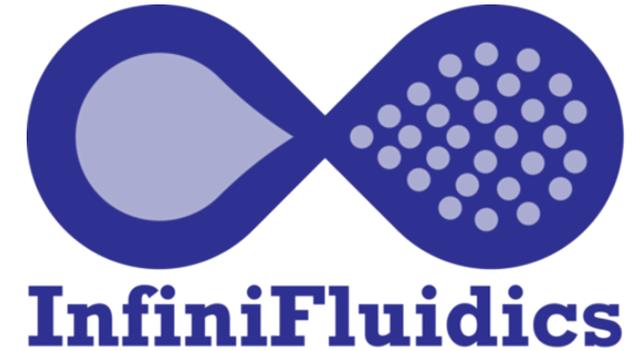


- Funding accrued in 2021 by MANTH startups:
 - \$11.7M in SBIR grants received by 10 startups at MANTH
 - \$20.5M in Series B funding for *Graphwear* – a company that began at MANTH
 - A total of \$33M in all forms of funding received in just this past year
- 16 startups are working in MANTH so far in 2022
 - 8 of which became first-time users this year
- Infini Fluidics
 - Nov 15, 2021: COREE partners with Infini Fluidics to develop new mRNA vaccine-making method
 - Feb 18, 2022: Penn Engineers Secure Wellcome Leap Contract for Lipid Nanoparticle Research Essential in Delivery of RNA Therapies

<https://penntoday.upenn.edu/news/faster-way-make-drug-microparticles>

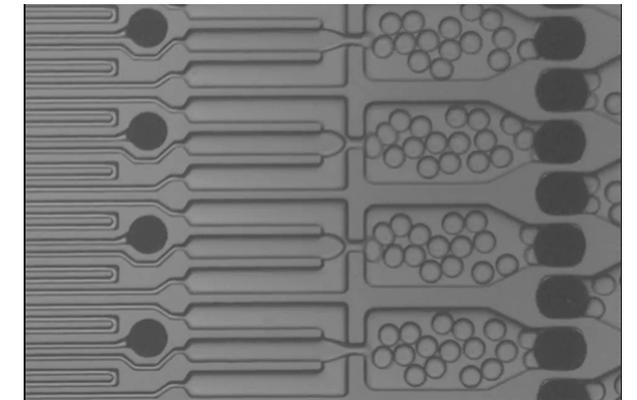
<http://www.koreabiomed.com/news/articleView.html?idxno=12586>

<https://blog.seas.upenn.edu/penn-engineers-secure-wellcome-leap-contract-for-lipid-nanoparticle-research-essential-in-delivery-of-rna-therapies/>



A \$60M PROGRAM JOINTLY FUNDED WITH C E P I

R3 RNA
READINESS +
RESPONSE



Mid-Atlantic
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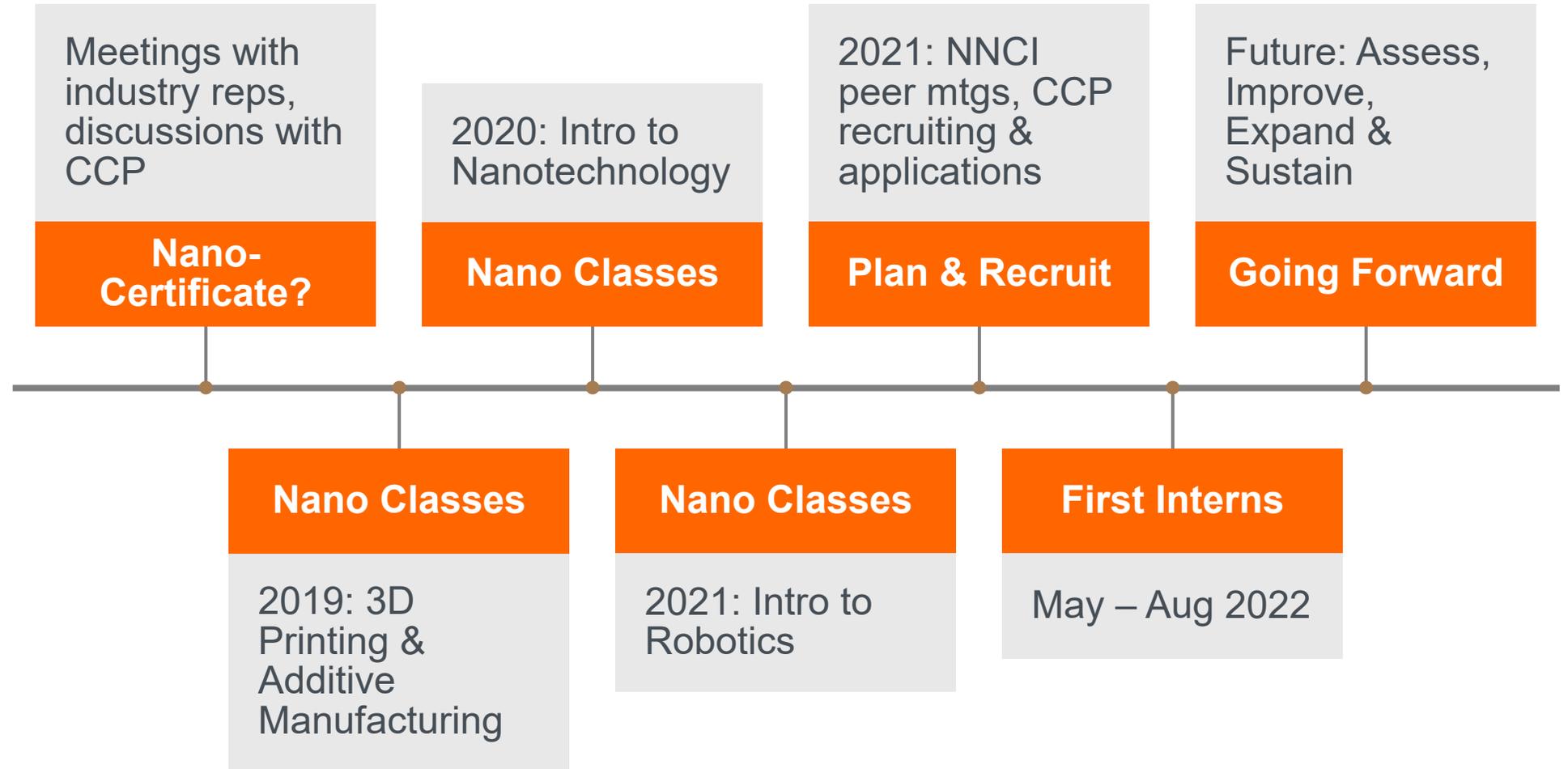
Community College of Philadelphia (CCP) Programs



Prof. Randy Libros



Prof. Linda Gerz





Internship Structure

- 3 interns, 20 hr/week, \$15/hr
- 14 weeks: May 16 – week of Aug 15 2022
- Working hours
 - (week 1 - 2) M – F: 4 hr/day
 - (week 3 – 14) M – Th: 5 hr/day, flexible hours
- Interns give presentation tri-weekly in the GSF meeting
- Attended some lecture and lab sessions in ESAP Nano
- Mentorship: Each interns has a GSF mentor
- MXene International conference at Drexel (8/1 – 3)
 - Poster: Colin and Michael with their mentors
 - Attend: Anton

Supervisor: QNF Principal Scientist (Dr. Gyuseok Kim),

Interns: Michael Geraghty, Colin Bakum, Anton McFadden

Mentoring Team: QNF Director & Staff, Graduate (Master's) Student Fellows



Mid-Atlantic
Nanotechnology Hub



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- Week 1: safety orientation, conventional nanofabrication (lithography, etch, deposition) hands-on lab
- Week 2: non-conventional nanofabrication (soft-lithography) hands-on lab
- Week 3 - 6: Personal projects (Solar cell, 2D graphene transistor, microfluidics)
- Week 7 - 8: Maintenance
- Week 9 - 13: Personal projects (Solar cell, 2D graphene transistor, microfluidics), ESAP Nano, Mxene conference
- Week 14: Wrap-up/Presentations

Device-specific process experience

C. Bakum: 2D graphene transistors

M. Geraghty: solar cells

A. McFadden: T-Cell isolator & soft-lithography

Soft-skill enhancement through presentations

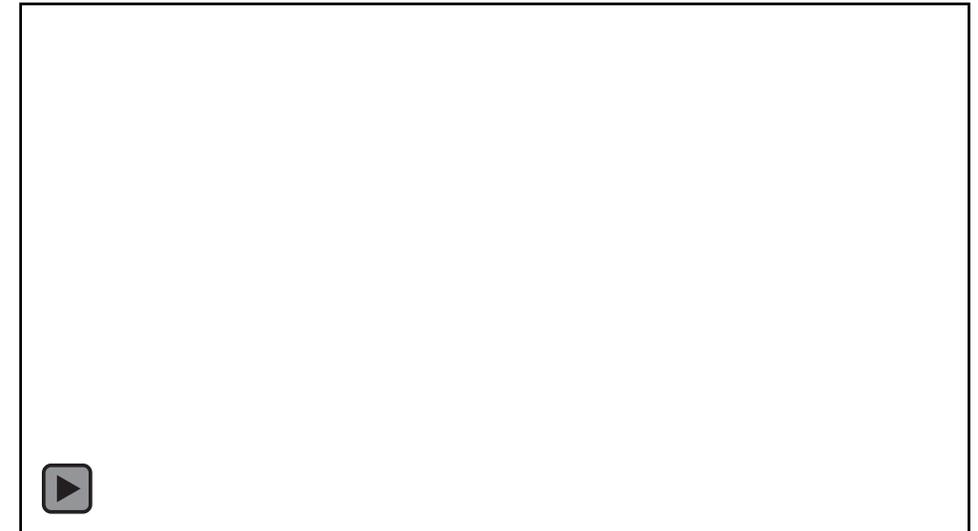
Public-facing videos



Solar cell fabrication



Results presentations to CCP
and Penn faculty and staff



<https://www.nano.upenn.edu/community-college-of-philadelphia-summer-internship-video-history/>

Immediate Post-Internship Plans

- ☆ Transferred to an Electrical & Computer Engineering B.S. Program at Temple University (8/2022)
- ☆ Finish CCP Assoc degree 5/2023 (Comp Sci)
- ☆ Finish CCP Assoc degree 12/2022 (Bio); Wistar Institute's Quality Science Pathway Apprenticeship
(Has also been offered a part time Singh Center position)



Ultimate Goals

Find an EE job in the local area.

Complete B.S. degree;
Work for a startup.

Entry level lab
assistant/research,
potentially abroad



Interns

- Liked the flexibility in internship hours (all were working other jobs over the summer)
- Some trouble scheduling equipment training; unstructured/inefficient time at the beginning

Staff/Mentors

- Training should be group training for efficiency
- Need for interns working on maintenance side (v. process development – 2022 cohort interests)



Quote from one intern: Over the course of my project, I was able to focus on this one project and solve problems related to it. I can take this experience to job interviews and discuss my project, the successes and failures, and my problem-solving experience.

At the start

How familiar are you with nanotechnology?

Interns ranked “exposure to nano” = 1.67 avg (scale from 1=“little to none” to 5=“a large amount”)

Things that you hope to have gained from the nano internship by the end of it...

(Combined responses) “Better understanding of/experience with nano, how it is used for innovation, of manufacturing processes, of advance equip in fabrication, of semiconductor tech & design, of experiments/projects, how to think critically”

After 14 weeks

(0=not sure/depends, 1=“not comfortable” to 5=“extremely comfortable”)

Rank (0-5)

How comfortable do you feel with:	First Day	Last Day	# of interns	Increased
...nano ideas & concepts	0	4	N=1	all interns
	3	5	N=2	
...learning to use new equipment	3	4	N=1	1 intern
	5	5	N=2	
...troubleshooting familiar equipment	0	5	N=1	2 interns
	1	5	N=1	
	4	4	N=1	
...scientific communication - oral	2	5	N=1	1 intern
	5	5	N=2	
...scientific communication - written	5	5	N=3	0 interns



- Oct. 24 Internship 2023 Info Session
 - Hybrid @ CCP w/ QNF Virtual Tour
 - 2022 Interns participating
- Applications & Recruitment for 2023
 - Reach out to CCP women (0 ♀ applicants 2022)
- Modifications to program (using feedback surveys from interns, supervisors/mentor team)

Fall 2022 INFORMATION SESSION

Monday, October 24, 2022
1-2 PM in Chem Lab W4-41

Or Join the Zoom Meeting
<https://ccp.zoom.us/j/94498062408?pwd=dEVsNkhHOF1OZWVhcnRlYU1jOTQ9>



Meeting ID: 944 9806 2408
Passcode: 165672



Nanotechnology Internship @ Penn

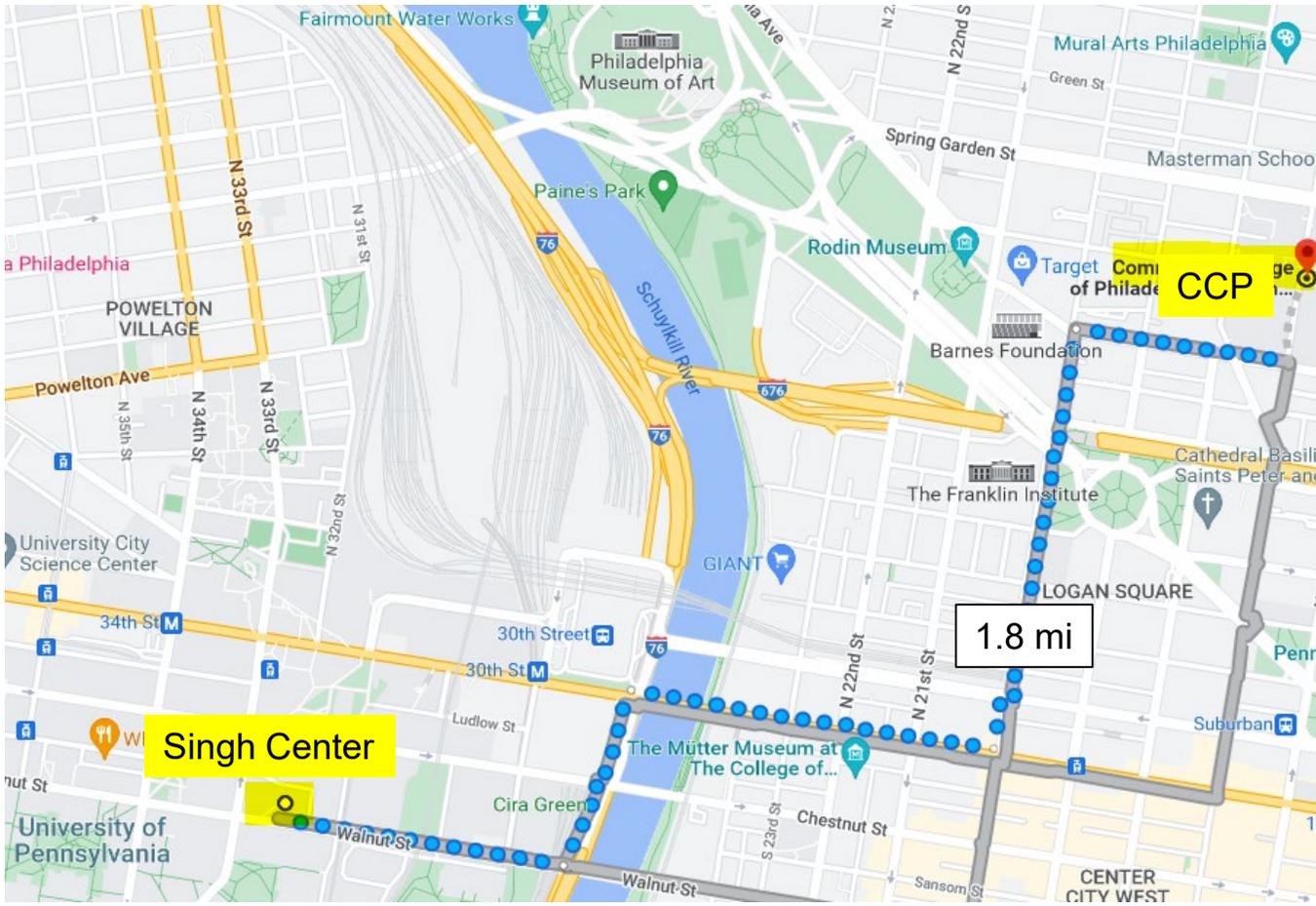


- Join us to hear from Penn's Singh Center colleagues and the first cohort of interns who successfully completed the internship this past summer.
- All interested students should attend to learn more about this exciting opportunity for Summer 2023!
- This is a **paid internship experience** during the 14-week summer session (20 hours per week) at the University of Pennsylvania's Singh Center (3205 Walnut Street, Philadelphia, PA 19104).

Background: The National Science Foundation supported Mid-Atlantic Nanotechnology Hub (MANTH), located at the Singh Center for Nanotechnology at the University of Pennsylvania, and the Community College of Philadelphia, have created a paid internship opportunity in nanotechnology for Community College of Philadelphia students. The program provides students with the opportunity to experience applications of advanced nanotechnology in a world-class cleanroom environment. CCP students would carry out this internship at the Singh Center over the course of a summer.

For more information, please contact Linda Orez at lerez@ccp.edu or 215-751-9623. The session will be recorded if you are unable to attend. Please send an email to receive the recording.

Visit the following websites for more information, application, and recommendation form:
<https://www.mycpp.online/department-science-and-health-careers/nanotechnology-internship-program>
<https://www.nano.usenn.edu/community-college-of-philadelphia-internship>



Community College of Philadelphia Student Body Composition

- ~72% minority
- 46% > 24 yrs old
- 74% low-income (i.e., Federal Pell Grant Aid recipients)

Thinking Ahead: Vision for the Future

- Match interns and employers
- Support more internship positions through direct partnership with industry (including our external users)
- Sustainability beyond NNCI