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Cornell NanoScale Facility 2022-2023 Research Accomplishments

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2022-2023 CNF Research Accomplishments

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PHOTOGRAPHY CREDITS

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2022-2023 CNF Research Accomplishments

DIRECTORS' INTRODUCTION

The Cornell NanoScale Science and Technology Facility (CNF) takes pride in presenting the research achievements of our users and research groups who utilize the extensive array of resources provided by the CNF. We appreciate all the contributors who provided input to this publication. The Research Accomplishments showcases excellence in research while underscoring the diverse array of cutting-edge advancements spanning various fields of science and technology. Together with the spotlight on 87 featured research reports, CNF-related patents, presentations, and publications (totaling nearly 391 in 2022) have been included.

NNCI

The CNF is excited to maintain its membership within the National Nanotechnology Coordinated Infrastructure (NNCI), supported by the National Science Foundation (NSF) and the New York State NYSTAR/ESD Matching Grant Program. This ongoing relationship plays a pivotal role in sustaining CNF's position as a leader in nanofabrication. Cornell proudly stands as one of 16 collaborative sites within this national user consortium, dedicated to delivering cutting-edge fabrication and characterization tools to a diverse range of users from both academia and industry. Earlier this year the CNF submitted "The Year 8 Annual Report" and actively engaged in a successful virtual, reverse site visit: reaffirming our commitment to our cooperative agreement with the NNCI.

CNF continues to take the lead in establishing the NYS Nanotechnology Network (NNN). Building on the success of our 1st student showcase in May of 2022, the 2nd Annual NNN Student Showcase/Career Fair highlighting "Advances in the Semiconductor Industry" was held at the University at Albany on April 15, 2023. Binghamton University hosted the 3rd NNN symposium at the Albany Nanotech Complex in conjunction with the 34th Annual Electronics Packaging Symposium at the beginning of September 2023. With the CHIPS and Science Act, the pending Micron fabrication complex in Syracuse, and associated NYS initiatives, workforce

development has assumed a stronger impactful presence in the region, further emphasizing the role of the NNN in uniting regional industry and universities.

NNCI STAFF AWARDS

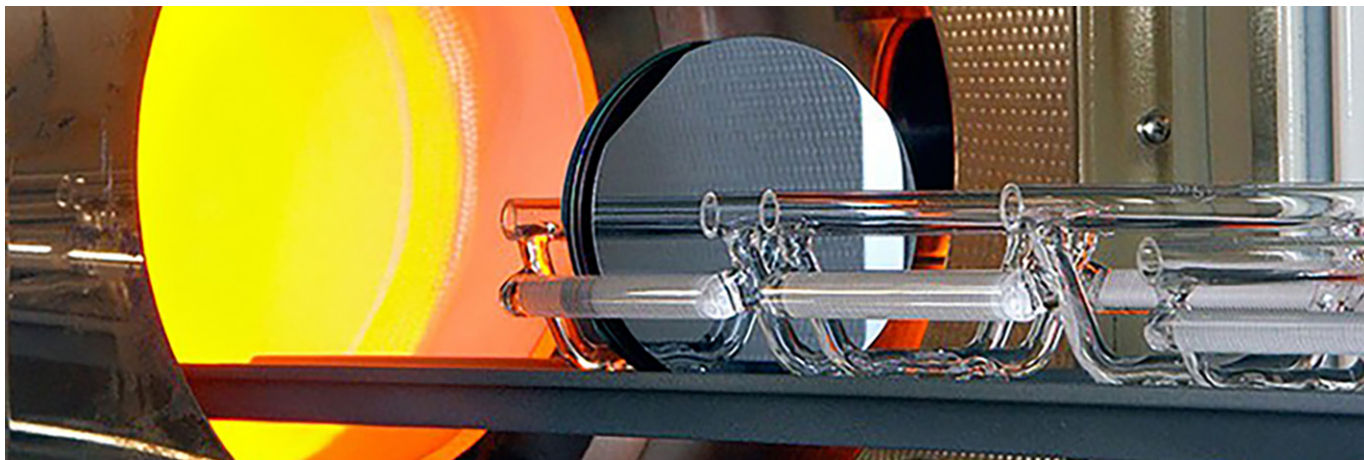
Congratulations to Karlis Musa who was recently honored with a national award from the NNCI. Annually, the NNCI acknowledges the efforts of NNCI staff who provide exceptional service and support to network users in the categories of Technical Staff, Education and Outreach, and User Support. Karlis was recognized by the NNCI in the User Support category. This award is given to site staff who provide excellent service and support to all network users. Karlis will receive a plaque, acknowledgement at the NNCI Annual Conference and will be recognized on the NNCI website and in the NNCI yearly report to the NSF. We are proud of Karlis' efforts and his contributions.

The exceptional staff at the CNF have been consistently recognized with NNCI Outstanding Staff Member Awards. Past award recipients include Chris Alpha – Technical Staff (2018), Tom Pennell – Education and Outreach (2020), Phil infante – Technical staff (2021) and Mike Skvarla – User Support (2021), Melanie -Claire Mallison – Education and Outreach (2022) and Aaron Windsor (2022) – User Support.

NEW TOOLS AND CAPABILITIES

New, more advanced capabilities are constantly being added at CNF to improve the user experience. Acquisition of new tools is guided by discussions with the advisory committees and Cornell faculty. CNF is in the process of replacing its 20-year-old lab management software with NEMO, an intuitive and easy to use laboratory logistics software suite designed by NIST. NEMO manages tool reservations, enables and disables tools, tracks usage, and provides billing of user charges.

A cutting-edge superconducting film deposition system has been ordered. This specialized AJA system is



designed specifically for quantum technology. We remain optimistic the delays presented by persistent supply chain issues will be resolved and the scheduled delivery date in spring of 2024 will be met.

Furnace tube A4 and A3 have been meticulously reconfigured to deposit LPCVD silicon carbide and high temperature LPCVD silicon nitride respectively. These upgrades are pivotal steps toward enhancing our capabilities and positioning ourselves at the forefront of groundbreaking research and innovation.

ME COMMONS NORDTECH

This past month Deputy Secretary of Defense Kathleen Hicks announced funding for the establishment of eight Microelectronics Commons regional innovation hubs. Cornell proudly stands as a founding member of The Northeast Regional Defense Technology Hub (NORDTECH). NORDTECH represents a regional coalition comprised of public and private sector experts in the Microelectronics Commons region in and around New York State. Within this alliance the CNF serves a pivotal role supporting a wide range of research and development activities. In addition, the CNF takes pride in its dedication to training and empowering the next generation workforce. This collaborative program will facilitate the integration of Department of Defense (DoD)-selected research and development projects. Harnessing the collective expertise provided by diverse stakeholders committed to fostering innovation is vital to the successful advancements of the field of nanotechnology. This initiative is expected to significantly expand the CNF's state-of-the-art micro-nanotechnology equipment as well as its user base while propelling the facility into the forefront of cutting-edge advancements in microelectronics and nanotechnology.

FUTURE OF NNCI

Given the conclusion of the current National Nanotechnology Coordinated Infrastructure (NNCI) award cycle in 2025, the nanotechnology community is looking ahead to the future and the next nanotechnology infrastructure. In September the CNF actively participated in the 2023 Workshop on Nanotechnology Infrastructure of the Future. The workshop was held in Washington, D.C., as well as online. Stanford led this interactive workshop. The breakout sessions helped capture input from attendees on various topics to prepare for the future. The input from everyone will assist with the development of a public-facing white paper including recommendations for a path forward for presentation to US government agencies.

EDUCATION AND OUTREACH

The CNF supports a broad range of educational and outreach (E&O) activities at all levels including K-12, higher education, professional and public. Last year we had over 2,600 participants in workforce and outreach activities in addition to the distribution of 100,000 copies of Nanooze. We have been working with Tompkins Cortland Community College (TC3) to establish a Micro-Credential in the semiconductor field and collaborating on a few NY State Workforce Development proposals.

We continue to collaborate with Micron on various Workforce Development activities including the Northeast University Semiconductor Network and Micron "Chip Camps". The "chip camps" are designed to introduce middle school students to the concept of microtechnology, and possible careers in the field. In 2023 we held three separate camps with > 300 students from Syracuse regional school districts. Tom

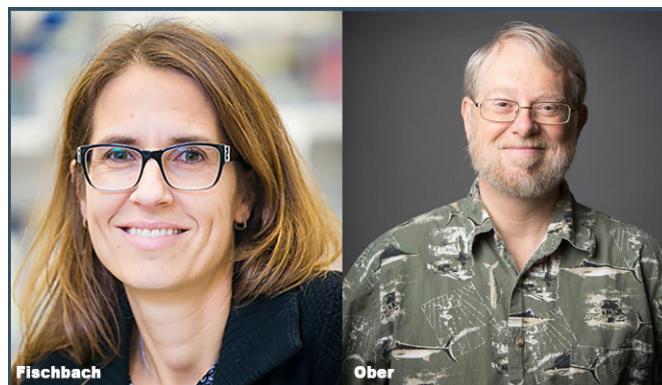
Pennell piloted ATLAS (Accelerated Training for Labor Advancement in Semiconductors), a program in cooperation with the Tompkins-Seneca-Tioga Board of Cooperative Educational Services (TST BOCES) New Visions Engineering to further workforce development educational opportunities. This program provided students with a comprehensive in person/hands on training in the key areas of the cleanroom semiconductor environment.

Since 1991, CNF has hosted an NSF-funded Research Experiences for Undergraduates (REU) Program — an informative ten-week summer research experience for a diverse group of talented undergraduates. We’ve since added two 2nd-year programs in collaboration with the National Institute for Materials Science (NIMS) in Japan — the CNF International Research Experiences for Undergraduates (CNF iREU) Program and the CNF International Research Experiences for Graduates (CNF iREG) Program. For the CNF iREU, we send 8-10 NNCI REU interns to Japan for a summer of international research and in return, for the CNF iREG, NIMS sends several Japanese graduate students to the NNCI sites. In 2023, the CNF hosted seven CNF REU interns, plus one CNF iREG. And eight NNCI REU participated in the CNF iREU Program. All their final reports can be found online at <https://cnf.cornell.edu/education> — along with websites for all the education and outreach activities mentioned above!



Above, the 2023 CNF REU Interns BEFORE the program.

Below, the 2023 CNF REU Interns AFTER the program!



LEADERSHIP LEGACIES

The Directors extend their genuine gratitude to Prof. Christopher Ober, the 8th Lester B. Knight Director of the CNF (2016 -2023) for his exceptional leadership in support of the CNF. Chris’ unwavering commitment to excellence, visionary guidance, and exceptional ability to strategically position the CNF for the future has left an indelible mark on both the NNCI and the CNF itself. His dedication and innovation has not only elevated the CNF to new heights but has contributed significantly to the advancement of nanoscience and technology on a broader scale. Chris is leaving a legacy for future generations. We wish Chris the best and look forward to seeing him around campus.

We would also like to thank Prof. Claudia Fischbach-Teschl, Associate Director (2020-2023), for her support and guidance during her tenure. Claudia’s insight and expertise further enhanced the CNF’s support of Life Sciences. Her collaborative nature paired with her dedication and leadership greatly enhanced the CNF mission.

Thank you, Chris, and Claudia, we wish you both the best in your future endeavors. Your daily presence will be missed by all at the CNF!



Judy Cha, Lester B. Knight Director, and Ron Olson, Director of Operations (seated), with the award winning students at the 2023 CNF Annual Meeting and the award-funding sponsors. Hodges Photography.

2022-2023 CNF Research Accomplishments

A SELECTION OF 2022 CNF-RESEARCH-RELATED PATENTS, PRESENTATIONS, AND PUBLICATIONS

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