

# San Diego Nanotechnology Infrastructure (SDNI) to Fuel Science and Engineering Breakthroughs Through Research and Education



# SDNI Education, Outreach, Workforce Development

- **Invested over \$2M to enhance facility infrastructure for research and training**
  - \$1.6M from UCSD central administration
  - A dedicated lab space is being developed to expand our capacity for workforce development and training/education.
  - Extra staff is being recruited for the training programs.
- **Developed creative education and outreach programs**
  - Created virtual REU with hands-on experiments and AI training.
  - Ran science teacher summer schools.
  - Organized NNCI annual education symposiums with NSF NNI, NNCI sites, NNCO, school board officials, high school and middle school science teachers, school district administrators, education content developers, and other stakeholders.
- **Workforce Development**
  - Manufactured and disseminated integrated photonic education kit (IPEK) to professional schools, universities, and industry to help develop and train the much-needed, undersupplied photonics professionals.
  - Created a certificate nanotechnology internship program for 25 students.
  - Participated in an Advanced Technological Education (ATE) Center proposal led by Penn State University focused on training transitioning military and veterans in the field of nanofabrication and characterization. If awarded, SDNI will work with Southwestern College, a San Diego-based community college.

# SDNI Education, Outreach, Workforce Development

## SDNI developed a Nanophotonic Education Kit to support workforce development in photonic ICs

### Motivation

- Silicon photonics is rapidly developed into a key industry crucial to national competitiveness and security.
- Hands-on training is not readily available outside of special Ph.D. programs.
- Lack of training and re-training opportunities severely limits future photonics workforce.

### Features that support training

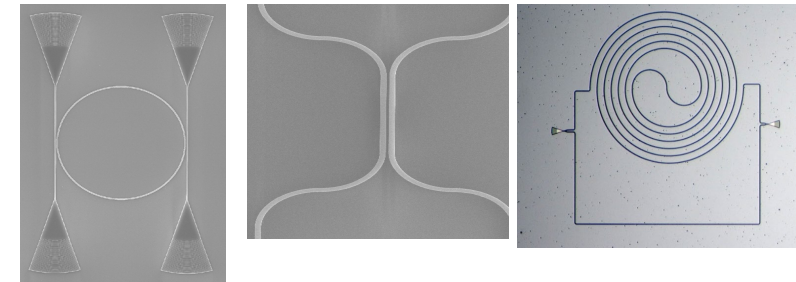
- Foundry fabricated components (e.g. rings, Bragg structures, MZI, etc...)
- Include tunable/reconfigurable devices.
- Easy to use with robust optical & electrical packaging.
- Provide turn-key operation with extensive instructions and manuals.
- Provide supporting software and UI.

### Impact

- Provide essential hands-on experiences with Si photonics.
- Bridge the gap between the needs for silicon photonics industry and today's education environment.
- Improve the quality of photonics education at all levels.
- SDNI has delivered IPEKs to technical schools (Bridgewater State University, Rose Hulman Institute of Technology), universities, and industry with strong, positive feedback.



Integrated Photonics Educational Kit (IPEK) prototype Board

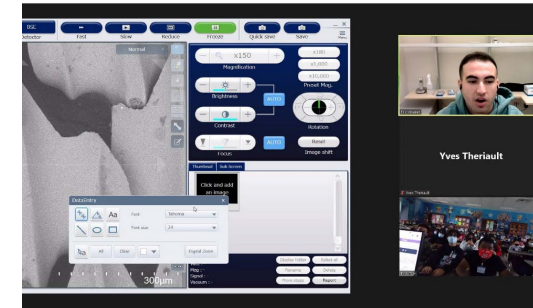


Test components include ring resonators, evanescent couplers, MZIs, and more!

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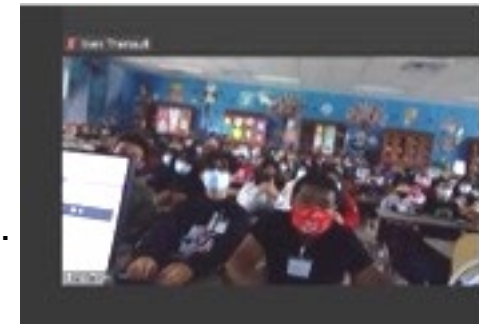
## K-12 STEM Education and Outreach – Hands-on Activities

- Through the RAIN (Remotely Accessible Instruments for Nanotechnology) network which includes 28 institutions, SDNI has performed 73 sessions and reach 1,852 students in 2021.
- SDNI helped other NNCI sites (Stanford University and GA Tech) by providing remote SEM sessions to assist nano@stanford and SENIC in their ' Nanotechnology Summer Institute for Middle School Teachers (known as NSIMST).



## 2021 REU Virtual Program with Hands-on Experiment (with 10 REU students)

- Summer school lectured by Prof. Mike Sailor : 2 hours of nanotechnology lectures M/W/F for 6 wks.
- Projects with AI Python-based Data Science and Machine Learning hands-on activities
- Entrepreneurship education sessions.
- Academic development program.
- Research projects in small teams (blood clotting, 2D materials, nanoparticle drug delivery) mentored by professors.
- NNCI REU convocation.



## Workforce Development (graduate/postdoc level)

SDNI established an in-depth microscopy (TEM) training program for PhD students (15) affiliated with the UC San Diego MRSEC. The program is also extended to MRSEC summer school and will be run annually.

# SDNI Education, Outreach, Workforce Development

## Nanotechnology Summer Institute for Middle and High School Teachers

19 teachers attended our 2021 Nanotechnology Summer Institute to learn nanotechnologies, perform hands-on activities, participate in remote SEM sessions, and develop a Next-Generation Science Standard (NGSS)-aligned lesson plan which they can bring to their class. We augmented the program by recruiting 28 teachers for the 2022 Summer Institute (thanks for additional funding by UCSD). The combined number of teachers will have an impact on approximately **9,000 students per year**.

## NNCI NTEC (Nanotechnology Entrepreneurship Challenge) Competition

This year SDNI had the **top two teams at the NTEC competition**. Each NTEC team develops a **nanotechnology-enabled minimum viable product (MVP)**. The seven-week program culminates in a “pitch” event where teams share their progress with business leaders. The participants receive innovation and entrepreneurship education including a light I-CORPS training and develop a prototype of their proposed technologies.

## Retraining Veterans: MicroNanoTechnological Education Center (MNT-EC) Collaboration for Technical Nanotechnology Education

SDNI participated in a joint NSF Advanced Technological Education (ATE) Center grant proposal led by Dr. Osama Awadelkarim from Penn State University for **retraining veterans**. The program will pair 3 NNCI sites with 3 local Community Colleges located in the vicinity of the respective NNCI sites. SDNI will work closely with Southwestern Community College in this 4-year veteran retraining program.

# Engage Undergraduates in Nanotechnology Research

- **Sound and interesting research topics**
- **Understand the goals and motivations of the individuals**
- **Effective mentoring from PIs and PhD students**
- **Adaptable entry barriers for undergraduates of different technical background**
- **User friendly and supportive environment (facilities/labs)**
- **Forming a community with meaningful interactions**
- **Food and fun!**