San Diego Nanotechnology Infrastructure (SDNI)

How can an NSF-funded nanotechnology program help lead and nucleate the broader national nanotechnology infrastructure ecosystem?

- NSF NNCI Primary
- NSF NNCI Partner
- NSF NCN
- DOE NSRC
- DOC/NIST CNST
- NCI/NIH/HHS NCL

NCN: Network for Computational Nanotechnology

NSRC: Nanoscale Science Research Center

CNST: Center for Nanoscale Science and Technology

NCL: Nanotechnology Characterization Laboratory

| Yuhwa Lo Director | Andrea Tao Deputy Director | Shaya Fainman Deputy Director | Eric Fullerton CMRR Director | Duygu Kuzun EC Member | Fubo Tao Technical Director | John Tamelier Asst. Director | Yves Theriault Education/outreach Director |

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Newly Established Innovation Centers and Infrastructures

NSF Regional Innovation Engines

NSTC (National Semiconductor Technology Center)

NSF Mid-Scale Research Infrastructure
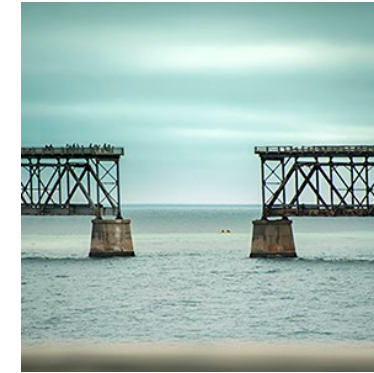
EDA: Regional Technology and Innovation Hubs (Tech Hubs) in 10 areas:
(1) Artificial intelligence; (2) High performance computing, semiconductors,; (3) Quantum information science and technology; (4) Robotics, advanced manufacturing; (5) Natural and anthropogenic disaster prevention or mitigation; (6) Advanced communications technology; (7) Biotechnology; (8) Data storage and cybersecurity; (9) Advanced energy technologies; and (10) Advanced materials science.

AWARDED

MICROELECTRONICS COMMONS

COMMONS

Applied Research Institute
Silicon Crossroads
Microelectronics
Commons Hub

Midwest Microelectronics Consortium
The Midwest Microelectronics Consortium Hub

AZ Board of Regents on behalf of Arizona State University
Southwest Advanced Prototyping Hub

North Carolina State University
Commercial Leap Ahead for Wide Bandgap Semiconductors Hub

The Board of Trustees of the Leland Stanford Junior University
California-Pacific-Northwest AI Hardware Hub

The Research Foundation for SUNY, acting on behalf of SUNY Polytechnic Institute
Northeast Regional Defense Technology Hub

Massachusetts Technology Collaborative
Northeast Microelectronics Coalition Hub

University of Southern California
California Defense Ready Electronics and Microdevices Superhub Hub

DREAMS
Defense Ready Electronics and Microdevices Superhub

- SDNI plays a significant role in the SolCal hub by offering its extensive semiconductor processing and characterization capabilities to support lab-to-fab transition.

- SDNI helps nucleate 7 university nanotechnology facilities in SolCal. Also coordinates and collaborates with NorCal facilities (Stanford, Berkeley, UC Davis).

- SDNI leverages its heterogeneous integration and enhanced CMOS technologies to support research in 5G/6G communications. The core capabilities also contribute to other areas of DoD ME Commons' interests: AI hardware, leap-forward technologies, electronic warfare, quantum technology, etc.
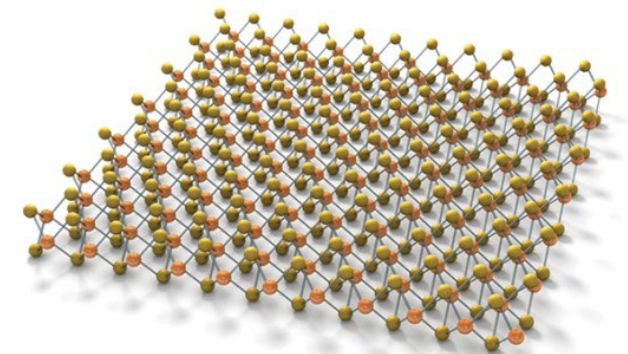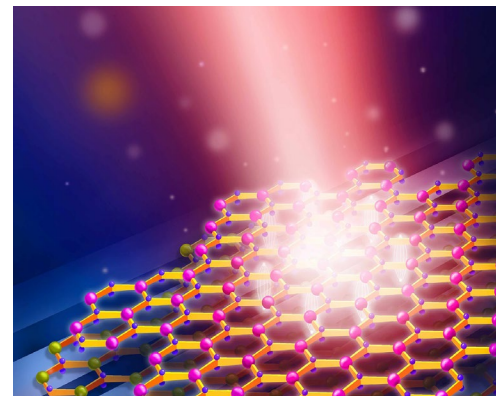
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SDNI Helps Nucleate DoD ME Commons Regional Technology Hubs
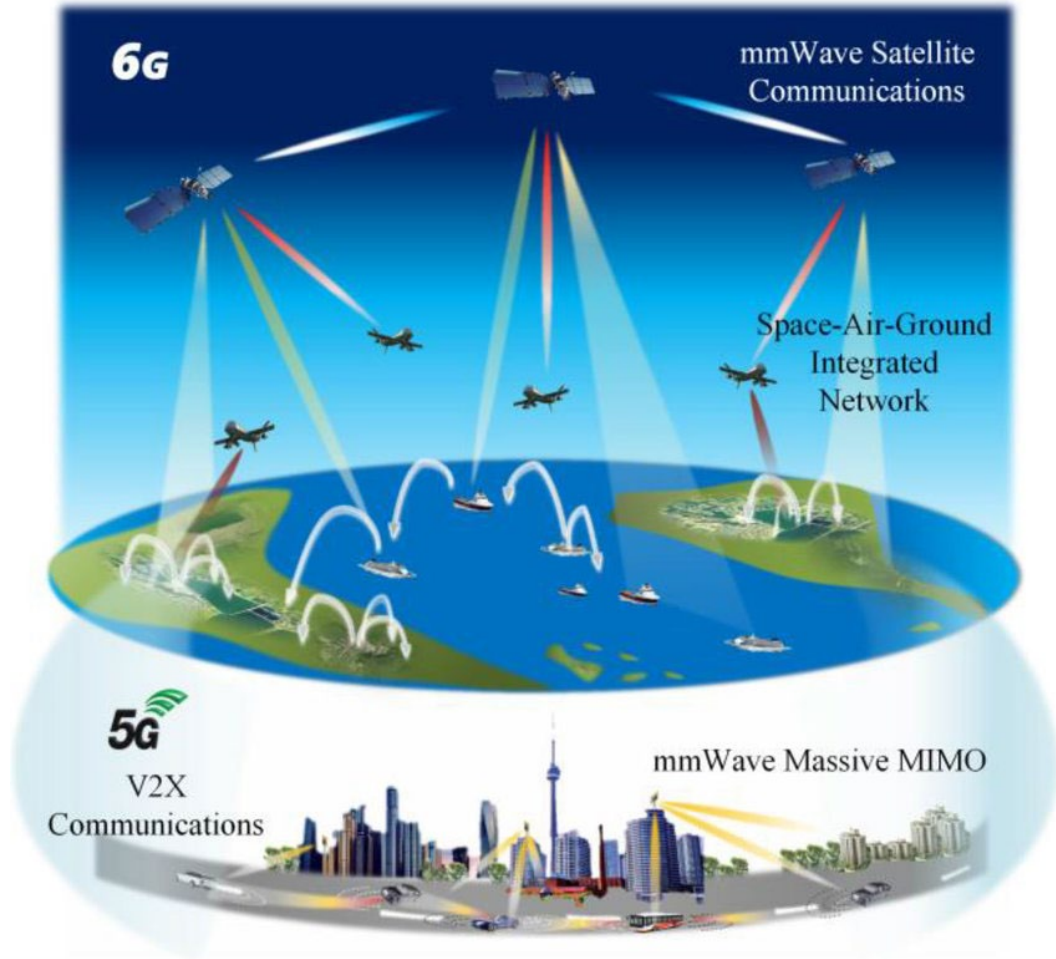
2.5D and 3D Heterogeneous integrated system

Vdd, Control/SPI, LO and IF distribution
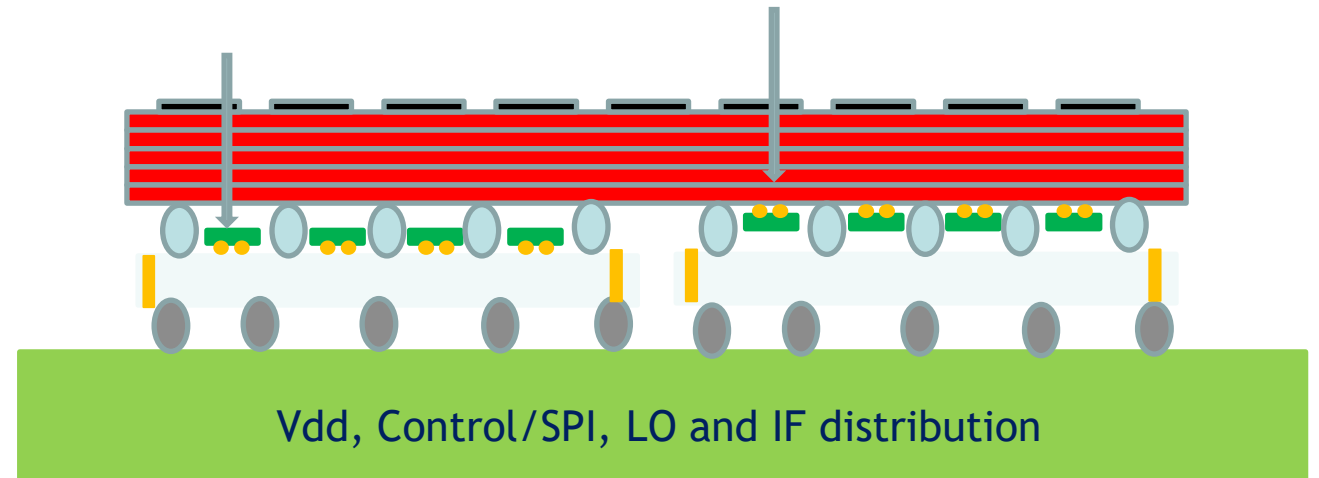
Integrating functional novel materials to enhance CMOS

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SDNI Supports Nanotechnology Ecosystem for Workforce Development

- Nanotechnology infrastructure must be paired with a highly skilled workforce, including technicians, BS, MS, and PhD degree scientists and engineers.

- SDNI leads and nucleates education and workforce development programs to support the broad nanotechnology infrastructure ecosystem.

- SDNI has promoted early awareness of nanotechnology and has **helped integrate nanotechnology in NGSS-aligned science curricula in K-12 classrooms**. We have trained 67 middle and high school science teachers through Nanotechnology Summer Institute, offered remote SEM sessions to more than 4500 students from 26 high schools/community colleges.

- We have partnered with Southwestern College, a San Diego-based community college, and helped Southwestern College start a nanotechnology program.

- In collaboration with Penn Stated University and Southwestern College, we have provided veterans hands-on training in nanofabrication and characterization.

SDNI Worked with Photonics Foundries and Offered Photonics Packaging

SOME OF THE AVAILABLE OPEN-ACCESS SILICON-ON-INSULATOR FABRICATION FACILITIES

Foundry	Technology	Direct Access	Waveguide Thickness (nm)
ASP	e-beam	Direct	220
ANT	e-beam	Direct	220
CornerStone	e-beam & deep UV	Direct	220, 340, 500
AMO	e-beam	Direct	220, 340
AIM	-	MOSIS	-
CEA-LETI	193	Europractice	310
IHP	248	Europractice	220
IMEC	193	Europractice	220
IMECAS	-	SPP	220
INPHOTEC	e-beam	Direct	220
Sandia National Labs	-	Direct	240
VTT	UV	Direct	3000
AMF	248/193nm	Direct	220, 340
CompoundTek	193 immersion	Direct	-
Global Foundry	193 immersion	Direct	100
SMIC	-	Direct	340
TowerJazz	193nm	Direct	-

Cost Structure

Integrated Photonics   Microelectronics

Packaging / Test   Device
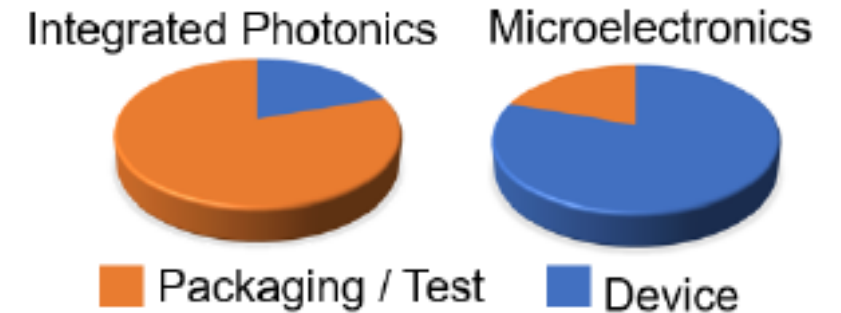
SDNI (CSPTF) Integrated Photonic Packaging

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Points for Panel Discussion

Topics: How can an NSF-funded nanotechnology program help lead and nucleate the broader national nanotechnology infrastructure ecosystem?

- There is a surge in specialty, mid-scale, and large-scale technology infrastructures and innovation centers nationwide, initiated by federal agencies (NSF, DoC, DoD, NIH). Most of the infrastructures have specific technology focus driven by their missions. NNCI facilities cover the broadest range of nanotechnology, from the most fundamental to the mid-high TRL technologies in many disciplines of science and sectors of industry. NNCI can play the role of the "**foundational infrastructure**" in the infrastructure ecosystem.

- The next phase of NNCI can
    (i) offer the most advanced tools and supports for nanoscale science and engineering research **in the most diverse fields and disciplines**, complementary to specialty hubs and centers**.**
    (ii) become an enabler, initiator, and test ground to **integrate advanced nanotechnologies and AI/ML**.
    (iii) become a "**superhub**" of other nanotechnology and semiconductor infrastructure.

NNCI

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