Texas Nanofabrication Facility (TNF) Seventh Year Report

- ✓ **Fabrication at MRC cleanroom**
- ✓ **Metrology at TMI**
- ✓ **Nanomanufacturing at NASCENT nm-Fab**
- ✓ **Added ACC as a partner for year-long REU program for 5 students**
- ✓ **New effort on Computation and Webinars related to Quantum Leap**

Microelectronics Research Center
THE UNIVERSITY OF TEXAS AT AUSTIN

TEXAS MATERIALS INSTITUTE

NASCENT

AUSTIN COMMUNITY COLLEGE DISTRICT

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nm-Fab Director

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Computation

A. Quinonez
ACC

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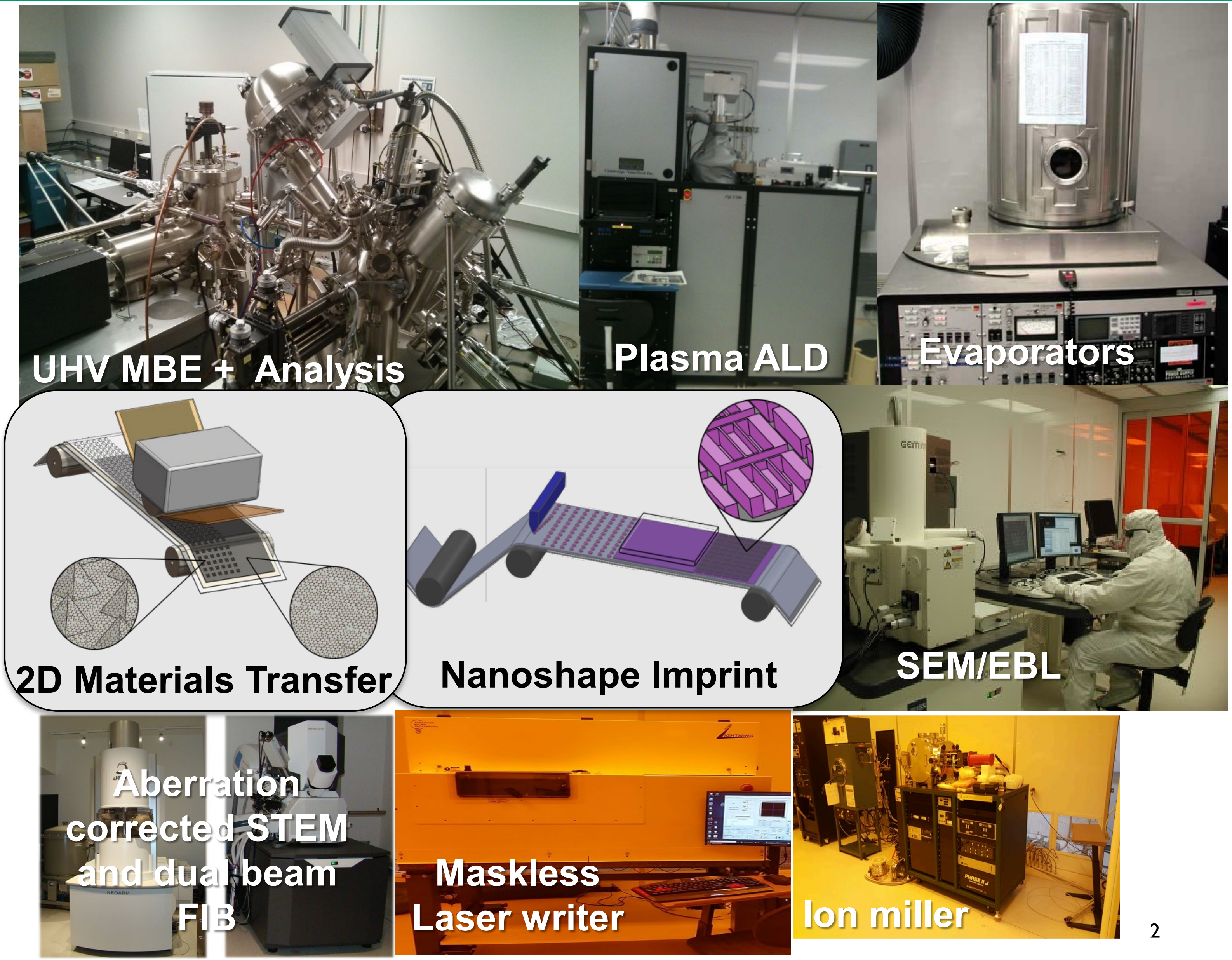
TNF Resources – 130+ tools and 25 Staff (7 funded by NNCI)

- 15,000 sq. ft. of Class 100 cleanroom at MRC
- Advanced Metrology at TMI
- 5,000 sq.ft. nano manufacturing at nm-Fab

- 1.2M$/yr. from UT and 1.3M$/yr. user fees



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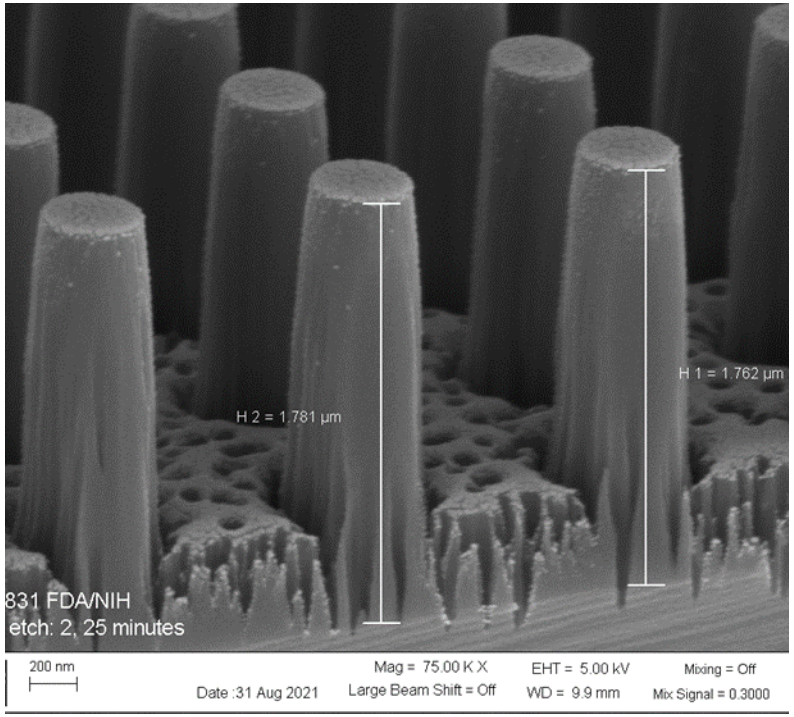
Nanomanufacturing-Fab (nmFab) Facility
Prototyping projects will be done by TNF for ~30k$+

Unit Process	Wafer Substrates	Roll-to-Roll Substrates
Substrate type	3", 4" and 6" diameter wafers (silicon, glass, flex polycarbonates, others upon request)	Flex polycarbonate substrates, widths ranging from 80 to 350 mm.
Initial Substrate Prep	Wet wafer clean	Linear ion source for organic contaminant removal
Patterning	Nanoimprint Lithography	Nanoimprint Lithography
Vacuum Deposition of Thin Films	E-beam and sputtering deposition of metals and dielectrics	E-beam and sputtering deposition of metals and dielectrics
Wet Processing of Thin Films	Spin Coating, Ink-jetting	n/a
Etch	Wet etching and reactive ion etching	Wet etching and reactive ion etching
Final Substrate treatments	Wafer Dicing available	Roll slitting, protection of patterned surfaces with polymer interleaf layers

Polarization Metasurface Detection Device for Food Safety

The ongoing effort in food safety diagnostics is in constant need of tests, which are more deployable (i.e. lower-cost and more compact), with the utmost accuracy. Metasurface-based optics offer an opportunity to meet these goals. Nanohmics seeks to develop a polarization metasurface-based biosensor, which is robust against vibrational and background noise, in order to develop a highly sensitive washless “bind and detect” assay with rapid testing (within minutes), high-throughput multiplexing, and portability to ports of entry and food processing plants.



Mark Lucente, Nanohmics. Work performed at Texas Nanofabrication Facility.
This work was supported by FDA SBIR 1 R43 FD006910-01.

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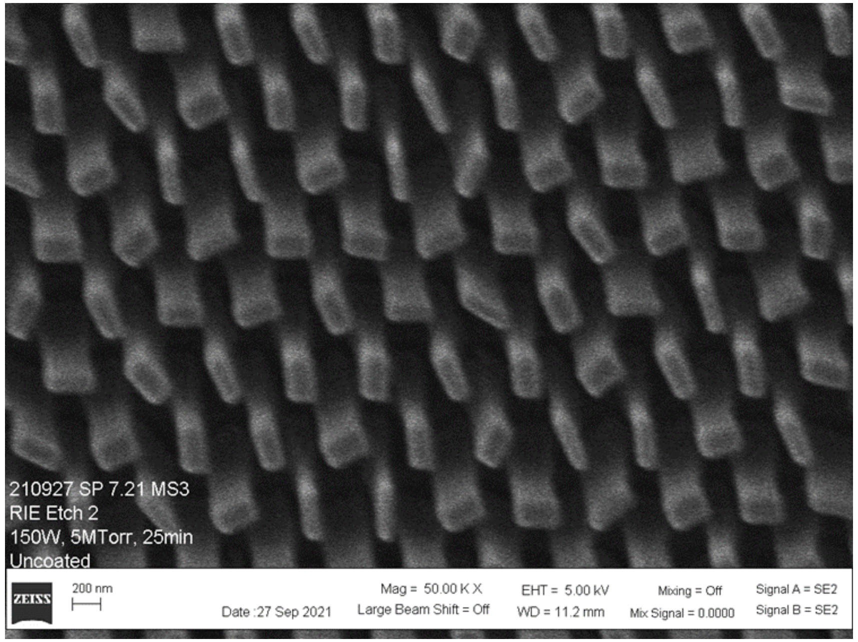
Compact Imaging Spectropolarimeter Based On Multifunction Meta-optic

The overall goal of this program is to develop a low-SWaP imaging spectropolarimeter using an ultrathin, light-weight, microfabricated multifunction meta-optic. Because of their extremely low mass and thickness, these low-aberration optics are ideal for sensors and imagers in SWaP-constrained vehicles. Both orbital and cost-effective suborbital Earth science measurements can benefit from instruments with small size, weight and power consumption (SWaP). Low-SWaP spectral imagers accelerate data collection such as atmospheric aerosol absorption and scattering. Metamaterial optics provide dramatic reductions in mass and thickness compared with traditional optics, which often require bulky supporting structures. A multifunction meta-optic combines the optical functions of multiple conventional optics, further reducing cost, volume, and mass while enhancing sensor performance and robustness.



Mark Lucente, Nanohmics. Work performed at Texas Nanofabrication Facility.
This work was supported by NASA SBIR 80NSSC21C0302

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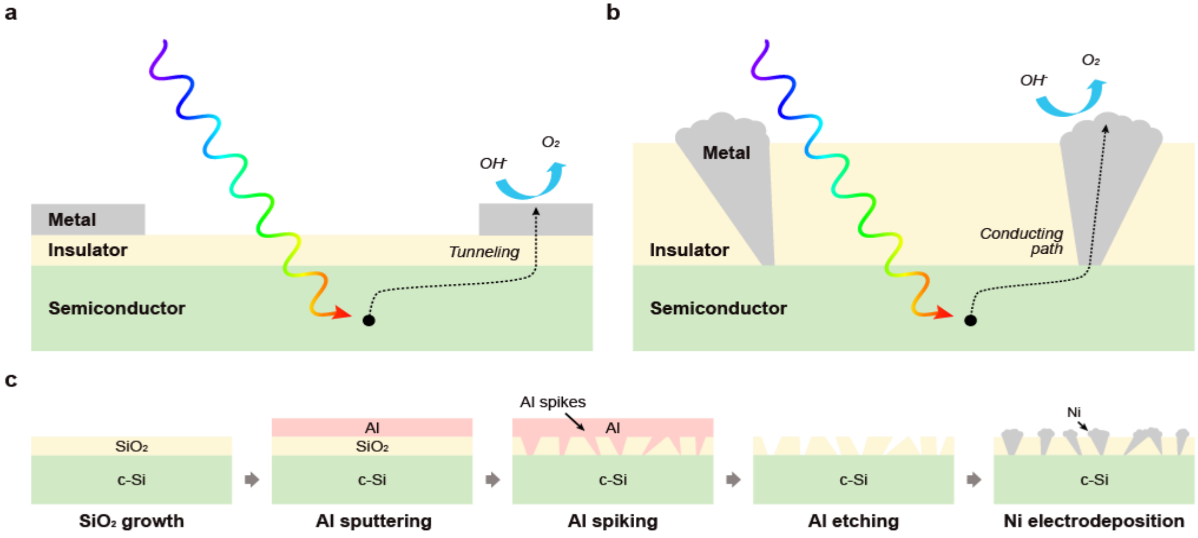
Internal Academic User: Prof. Ed Yu, UT Austin)

High-Performance Metal-Insulator-Silicon Photoanodes for Solar Powered Water Oxidation

In work supported by CBET and DMR, the latter through the Center for Dynamics and Control of Materials: an NSF MRSEC, researchers in Edward Yu's laboratory have demonstrated a low-cost, scalable approach for fabrication of high-performance, extremely stable photoanodes for solar-powered water oxidation. Such devices are a key element in systems for using the power in solar illumination to split water molecules into hydrogen and oxygen. A fundamental issue plaguing conventional semiconductor photoelectrodes is that semiconductor materials that are efficient absorbers of solar illumination, e.g., silicon, are easily corroded in the liquid environment in which solar-driven photoelectrochemical reactions typically must occur. Incorporation of a wide-bandgap electrically insulating protective layer atop the semiconductor to separate the semiconductor from the solution has been explored quite extensively as an approach to improve stability, resulting in the development of metal-insulator-semiconductor (MIS) photoelectrodes. However, MIS photoelectrodes must contend with the challenge of providing efficient transport of photogenerated carriers across the insulator to the catalyst (typically metal) at the device-liquid interface.



MIS photoanode for solar water oxidation

Soonil Lee, UT Austin.

This work was supported by NSF MRSEC at UT Austin.

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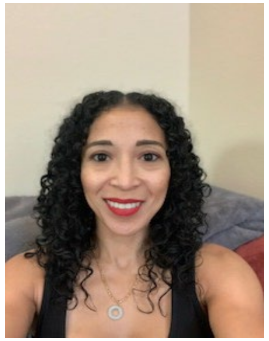
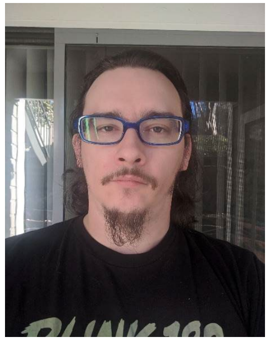
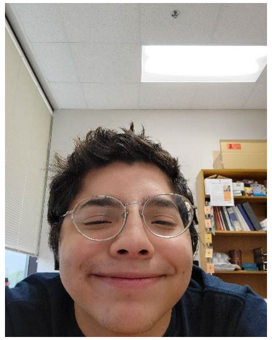
Education and Outreach: Targeting Underrepresented Groups

TNF has moved to a new REU model involving year-round engagement with Austin Community College students, with a focus on under-represented groups. We are training 5 ACC students (two women and three URMs.)

- Girl Day hosted by TMI. Targeted audience was 5th, 6th, and 7th graders. Program link: https://girlday.utexas.edu/activity-uttmi-grow-alum-crystals

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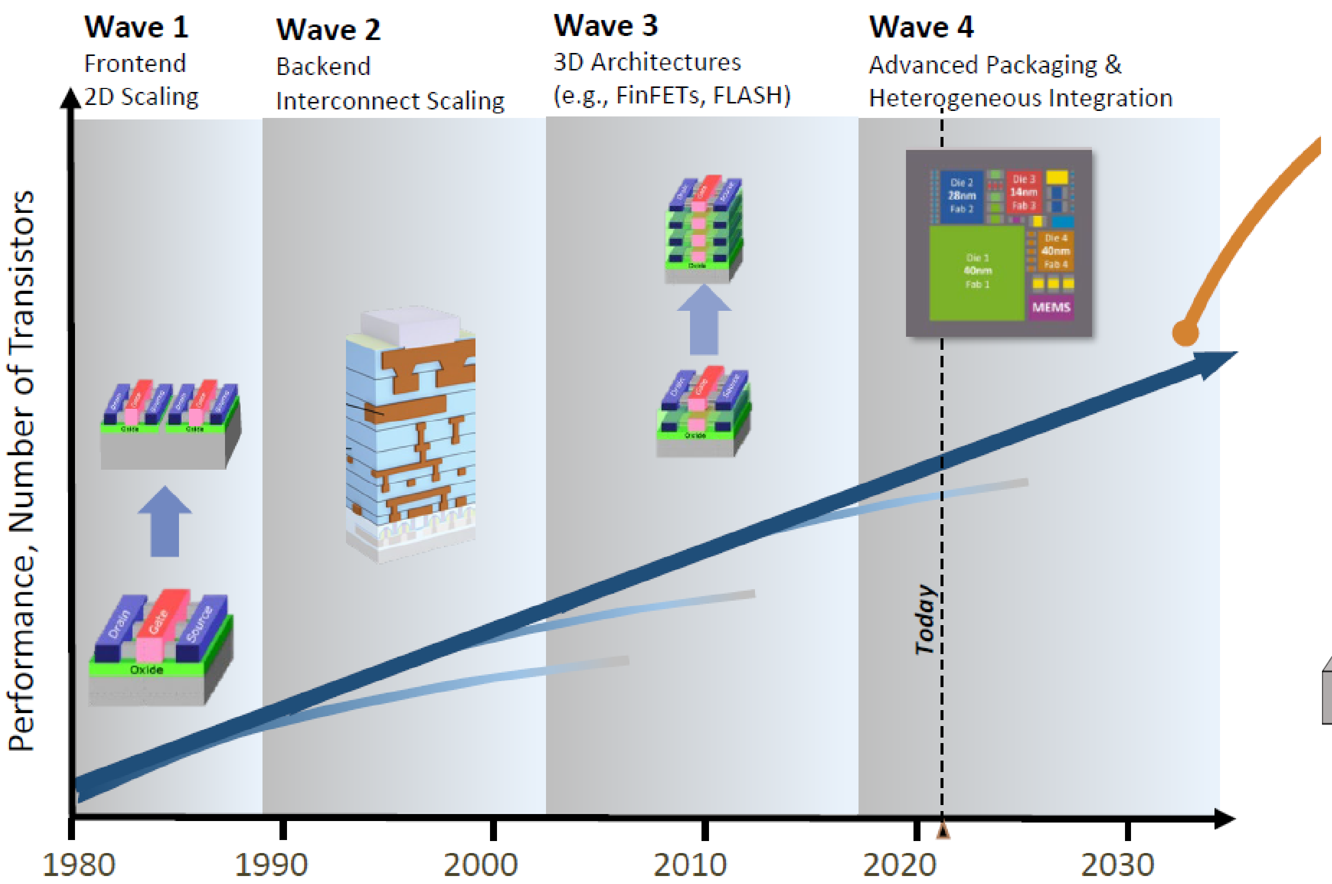
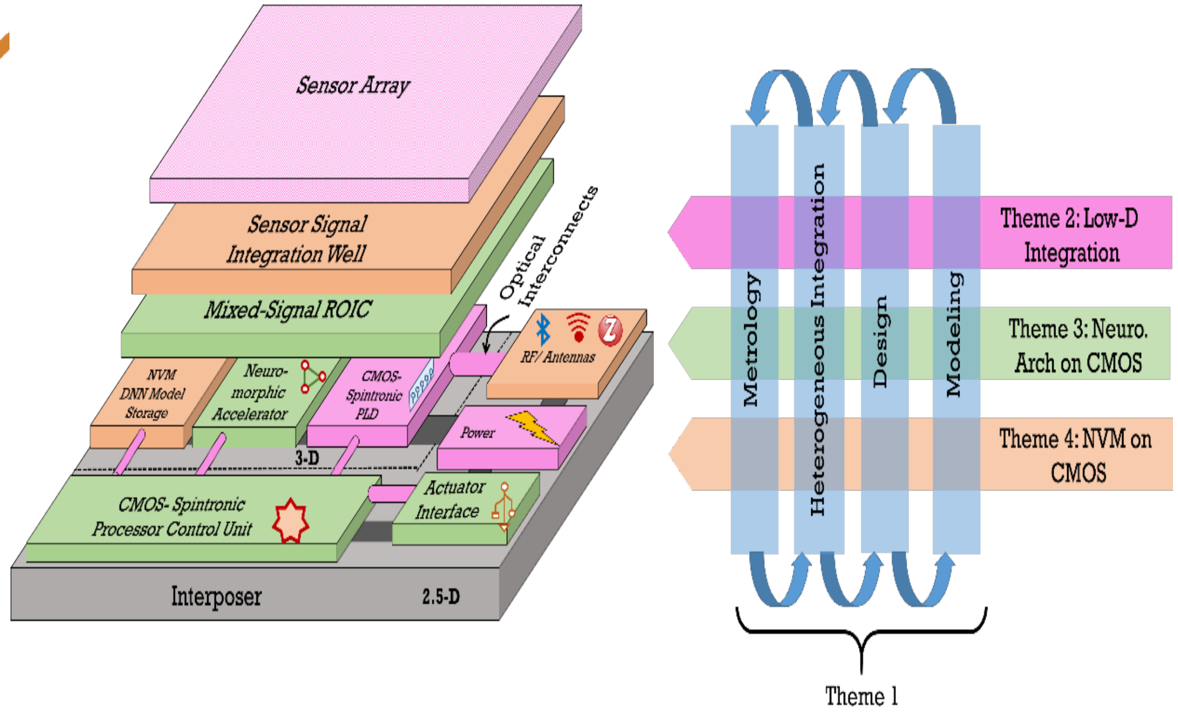
TNF: Microelectronics and the CHIPS+Science Act
Heterogeneous Integration Capability



Adapted from Presentation by Dr. Gordon Keeler DARPA HI Roadmap Annual Conference, 02/24/2021



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TNF: Microelectronics and the CHIPS+Science Act

- State of Texas has provided $110M to improve TNF
- Expanding cleanroom by ~10,000 sq. ft. by 2024
- Heterogenous integration capability
- 8” CMOS + X process line

TNF Impact and Future Goals

Impact:

- Enable and foster breakthrough nano-innovation - electronics, healthcare and energy

- Engage underrepresented minorities (URM), particularly Hispanics and women.

Future Goals:

- Science of scalability: (nmFab)
- Engage URM in NNCI-TNF: (ACC)
- Innovation Ecosystem
- Continue to improve with quarterly input from Executive Committee

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