

Texas Nanofabrication Facility (TNF) Sixth 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



S. K. Banerjee
Site Director



S. Majumder
Site Coordinator



L.A. Kahlor
SEI Director



S.V. Sreenivasan
nm-Fab Director



R. Manthiram
TMI Director



L.F. Register
Computation

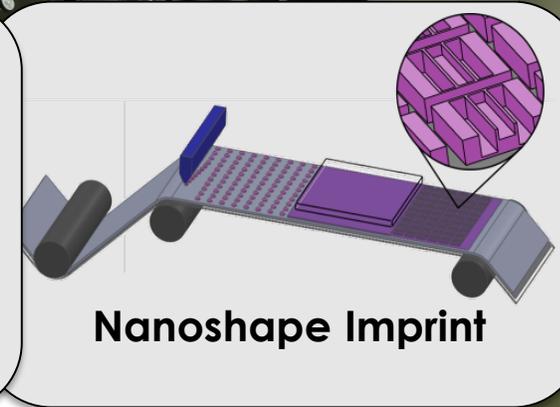
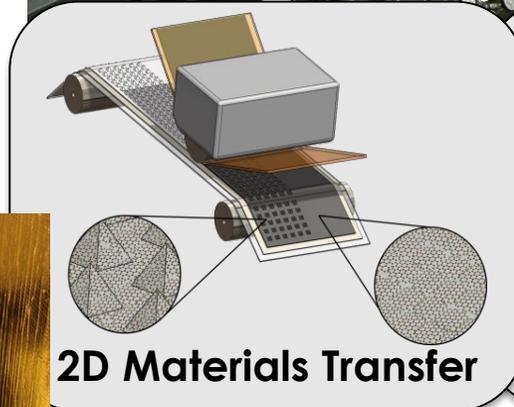
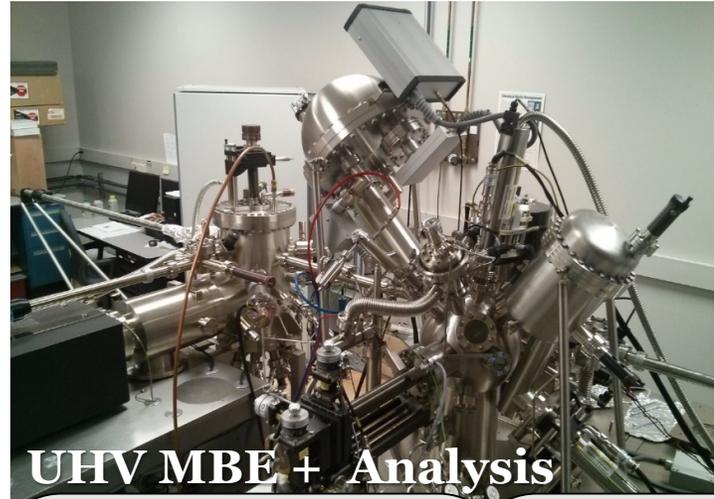


A. Quinonez
ACC



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



Nanomanufacturing-Fab (nmFab) Facility

Prototyping projects will be done by TNF for ~30k\$+

Unit Process

Substrate type

Initial Substrate Prep

Patterning

Vacuum Deposition of Thin Films

Wet Processing of Thin Films

Etch

Final Substrate treatments

Wafer Substrates

3", 4" and 6" diameter wafers
(silicon, glass, flex polycarbonates,
others upon request)

Wet wafer clean

Nanoimprint Lithography

E-beam and sputtering deposition
of metals and dielectrics

Spin Coating, Ink-jetting

Wet etching and reactive ion
etching

Wafer Dicing available

Roll-to-Roll Substrates

Flex polycarbonate substrates,
widths ranging from 80 to 350 mm.

Linear ion source for organic
contaminant removal

Nanoimprint Lithography

E-beam and sputtering deposition
of metals and dielectrics

n/a

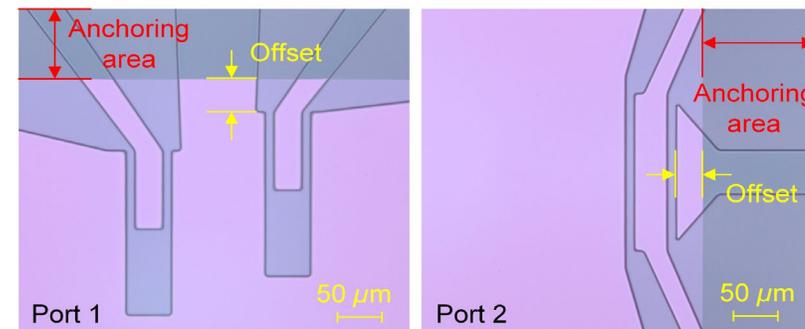
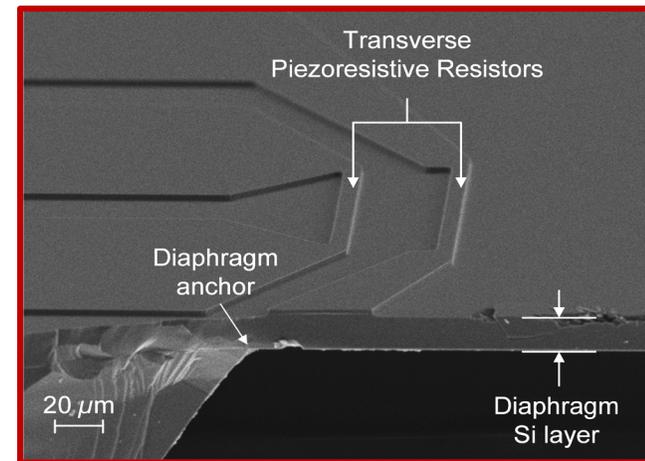
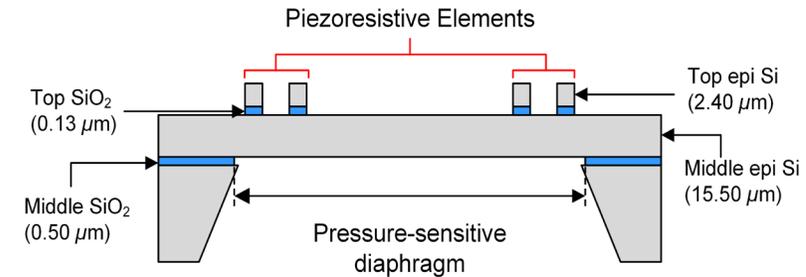
Wet etching and reactive ion
etching

Roll slitting, protection of
patterned surfaces with polymer
interleaf layers

Small Company User: Silicon Audio

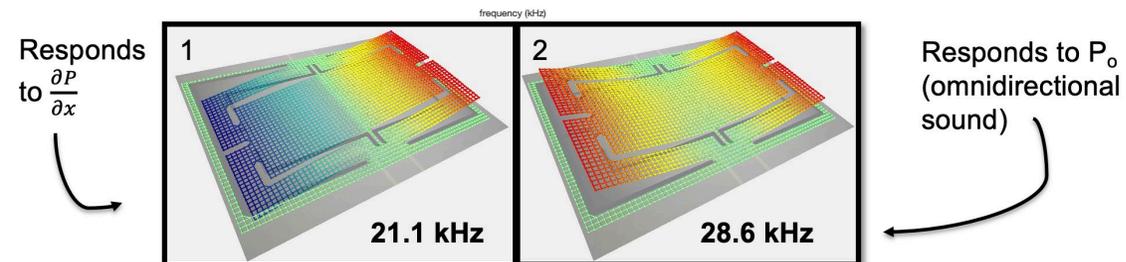
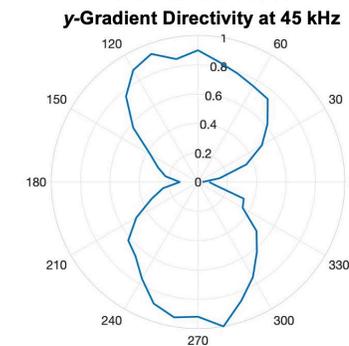
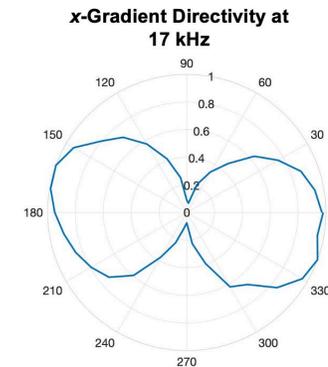
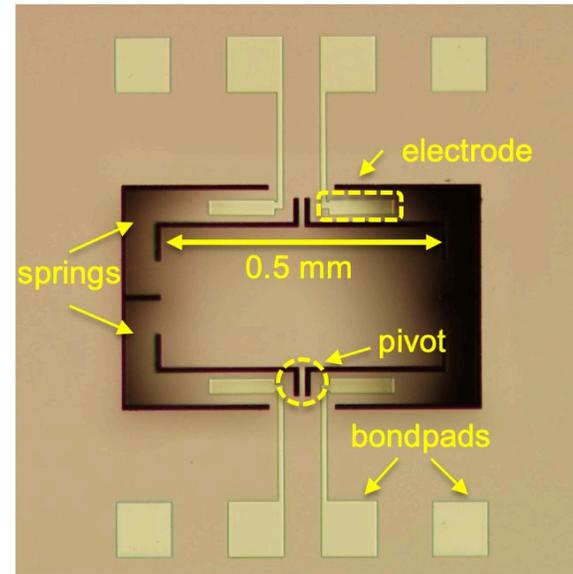
Infrasound Microphones Using Microfabricated Piezoresistive Silicon

- Sources of infrasound include volcanos, earthquakes, meteorites, and large man-made explosions. Infrasound from such events can be detected on the opposite side of the globe, as these low frequency waves are only mildly attenuated. Infrasound monitoring is one of three critical technologies used to monitor for nuclear testing activity.
- Infrasound sensors were fabricated at MRC using special double layer SOI wafers (two epitaxial layers separated by two layers of SiO₂). Piezoresistors were etched into the top-most epitaxial layer, and a KOH etch through the backside releases the mechanical diaphragm.
- The devices were packaged and are presently under evaluation at a rigorous testing facility on Kirtland Airforce Base in Albuquerque, NM.
- This project is sponsored by the Department of Energy.



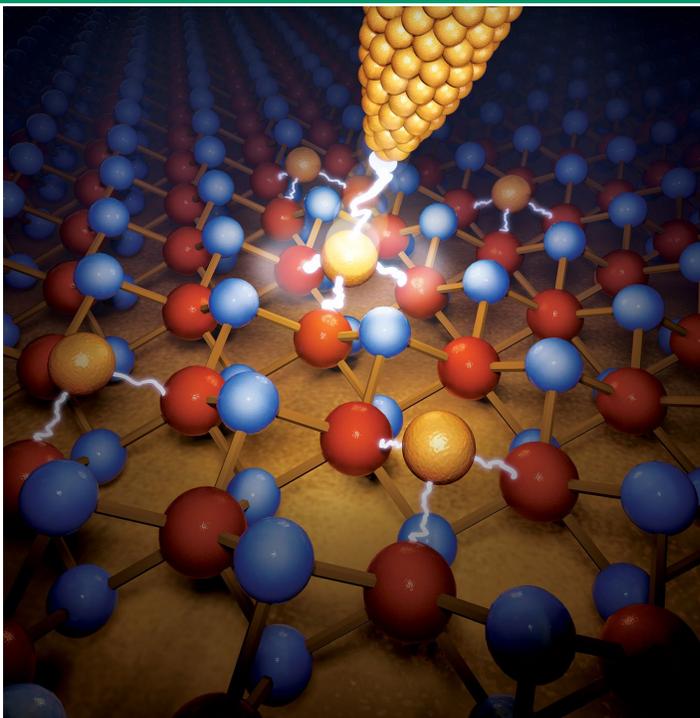
Fabrication of Fly-Inspired Microphones with Integrated Piezoelectric Films

- Single microphone structure capable of independently resolving pressure and pressure gradient in $x, y,$ and z . With 4 measurands in a single microphone, ambisonic recording is possible so that recordings can be played back with *true-to-life* surround sound.
- Target applications include hearing assistive devices, smart watches, and smart phones.
- The device is fabricated at MRC. Piezoelectric AlN film synthesis is achieved via reactive sputtering. With the help of MRC staff, a sputtering system (Oerlikon UNIVEX 450B) was modified with high-temperature substrate holders to enable synthesis of the films.
- Acoustic evaluation demands dicing and small-scale packaging. The MRC dicing tools were used to singulate, wire-bond, and package microphones for testing in UT's anechoic test chamber.
- **This project is sponsored by National Institute of Health (NIH) and Harman International.**



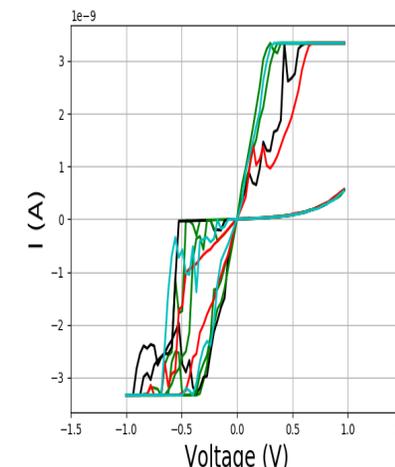
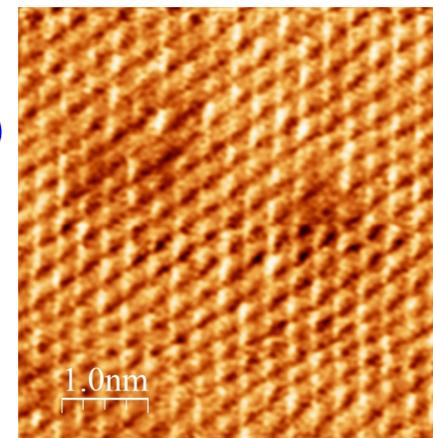
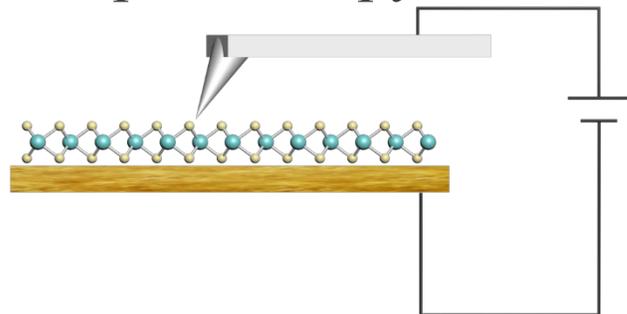
Internal Academic User: Deji Akinwande

Memristor using Single-Defect in MoS2 and RF Switch in hBN

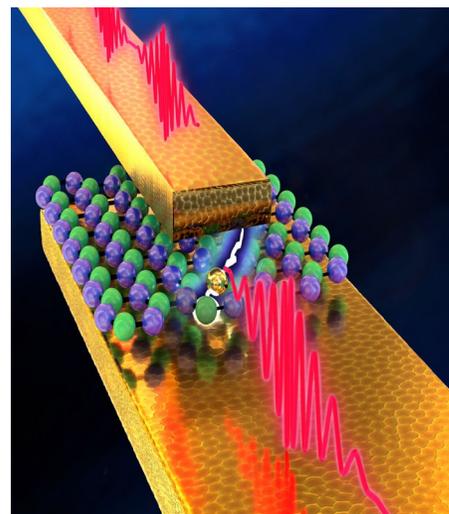


-imaging
-transport
-spectroscopy

Defect area
(single-defect)



Hus, .., Akinwande, Nature Nano, Nov. 2020



h-BN RF/5G Zero-Power Switches up to 130 THz

Kim, ..Akinwande, Nature Electronics 2020

TNF Impact and Future Goals

Impact:

- Enabling and fostering breakthroughs in nano-innovation - electronics, healthcare and energy
- Engaging underrepresented minorities from Austin Community College

Future Goals:

- Science of scalability: (nm-Fab)
- Nurture small companies in the Southwest

