
***National
Nanotechnology
Coordinated
Infrastructure***

***Atlanta
Jan 2017***

Texas Nanofabrication Facility (TNF)

***Sanjay K. Banerjee
Site Director***



TNF UT-Austin Capabilities

- **3 centers from UT:** MRC (NNIN), TMI and NASCENT- ERC
- **20,000 sq ft of class 100 cleanroom space**
- **22,000 sq ft of characterization laboratories**
- **130 major tools** for silicon and III-V nano and microelectronics fabrication
- **15 technical staff** for safety training, equipment training, tool maintenance, installation, process support. **5 supported by NNCI.**

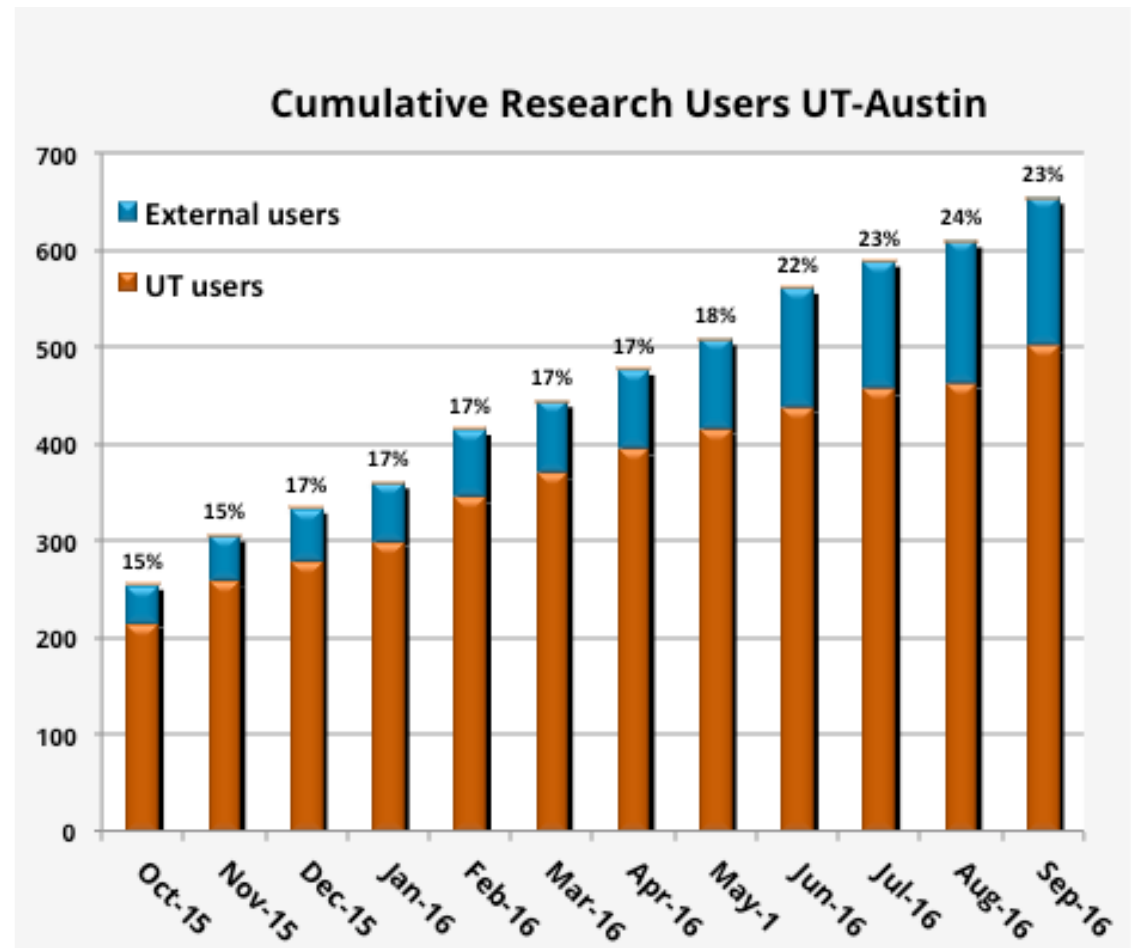


Texas Nanofabrication Facility New Tools

- **Laser Scanning Microscope LEXT OLS4100 from Olympus:**
Much faster data acquisition than AFM. For MEMS applications, it is equipped with a 50x large working distance objective (10.6mm) to measure deep etched features.
(**Acquired with MRC user fees.**)
- **Hysitron TriboIndenter TI 950:**
Nanomechanical and nanotribological characterization.
(**Donation- \$80k replacement cost**)
- **Small Angle X-ray Scattering Instrument with In situ Capabilities: s**
To be acquired mid-2017 and installed in new Engineering Education Research Center building and managed by TMI.
(**NSF MRI program**)

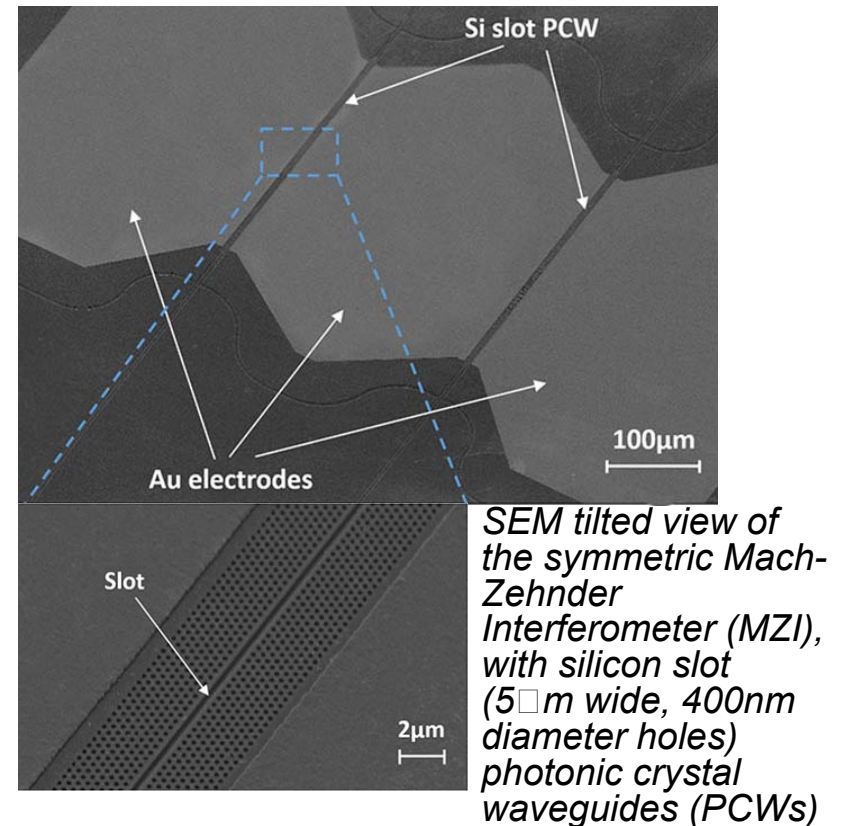
Texas Nanofabrication Facility Research Users—Year 1

- Over 650 unique users/year
- 23% External Users
- External Academic Researchers:** Rice University, Texas A&M, Texas Tech Amarillo UT Arlington, UT San Antonio, UT Rio Grande Valley, UT El Paso, Univ. Houston
- Companies:** Amethyst Research Inc., Applied Novel Devices, ATX Photonics, Canon Nano, Electroninks, Kinilitix, LAM, Luminex, Houston Methodist Hospital, Magic Leap Inc., Nanohmics Inc., Nanohybrids, NanoMaster, NanoMedical Systems Inc., Nantero, Optical Filter Source, Heltzel Company, SACHEM, Sheetak, Silexta, Stellaray, Superconductor Technologies Inc., Zyvex



Academic Impact

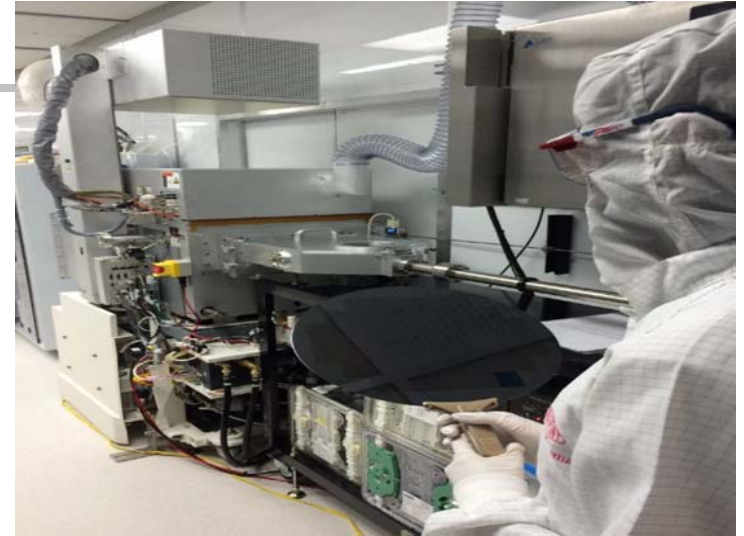
- Prof. Ray Chen, founder Omega Optics, gave an invited technology transfer tutorial “**Silicon Nanomembranes for Sensing Applications**” at the 2016 **Conference on Lasers and Electro-Optics Technology**.
- Nanoelectronics online course with lab modules being developed by **Sreenivasan** (NSF NASCENT)
- Nanotechnology tutorial to US Patent Office examiners by **Banerjee**



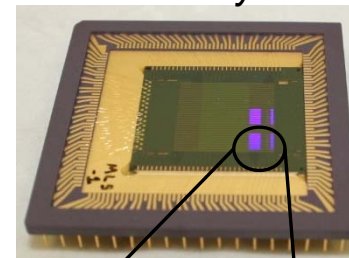
Industrial Impact

- **Canon Nanotechnologies, UT Austin startup using NNIN**, is the leader in nanoimprint lithography. Jet and Flash Imprint Lithography (J-FIL) creates 20nm line and space pattern (1/2 pitch). **Etching processes to transfer the patterned features from resist to the underlying substrate while maintaining acceptable critical dimensions being developed at TNF.**
- **Nanohmics** is a startup and NNIN/NNCI user since 2004, with currently over 15 SBIR projects worth \$6.5M. Rapid response metal oxide (MO_x) gas sensor arrays for real-time volatile organic compound (VOC) identification are designed with high surface-to-volume nanowire elements fabricated using **nano-imprint lithography.**

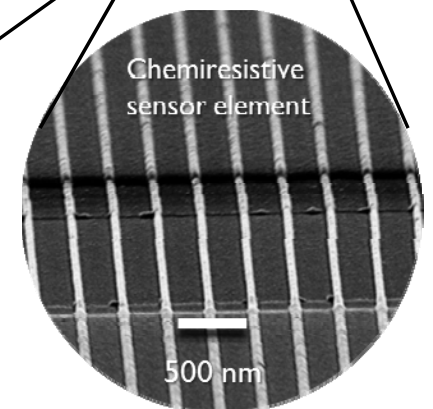
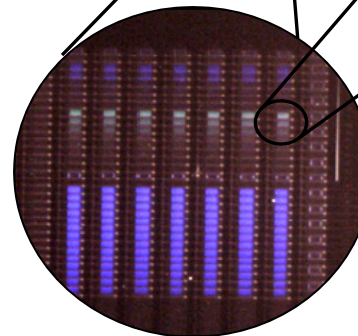
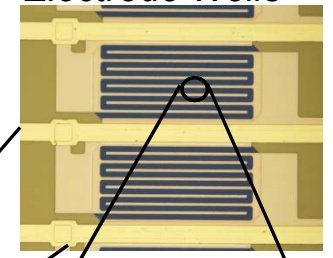
*Canon Nanotechnologies Dry Etch
Development scaleup for 300mm wafers*



*Packaged Multiplexed
Sensor Array*



*Sensor
Electrode Wells*



Social and Ethical Implications (SEI)

Prof. Lee Ann Kahlor, SEI Director

- *The SEI team has a 3-phase plan to normalize SEI as a part of the day-to-day practice of nanoscience.*
- *Ongoing messaging is now an integral part of our 3-phase plan.*
- *Our audience is users, faculty, staff, and visitors.*
- *Our team is aware of the work funded through NNIN to create posters related to SEI and we integrate those into our research efforts.*

1) Phase 1 Goal: Interviews and surveys.

2) Phase 2 Goal: Develop and disseminate messages to normalize SEI in nanoscience.

3) Phase 3 Goal: Track exposure to and ability to recall SEI messaging.

Educational and Outreach Activities

● REU program in Nanotechnology

- Since 2004, ~70 students hosted by UT.
- For last 5 years UT has hosted Japanese student through NIMS program.
- 5 NNCI REU interns in summer 2016:
 - ◆ 2 females: Grace Noel- Penn State, PI: Neal Hall, Katherine Keller – Washington State, PI: LeeAnn Kahlor,
 - ◆ 5 more NASCENT ERC REUs co-managed



● Workshop and Tours:

- ◆ **Secretary of State John F. Kerry** visited UT Austin MRC a week after he signed climate agreement at UN
- ◆ Cleanroom Tours: Chinese delegation of industry and academic leaders – Oct., 2016
- ◆ AFM- Park System Oct. 2106
- ◆ Polymer Pen Lithography (PPL)- TERA-print, Dec., 2016

