National Nanotechnology Infrastructure Network

at the University of MICHIGAN

Solid-State Electronics Laboratory

The University of Michigan Solid State Electronics Laboratory (SSEL) conducts research in electronic, optoelectronic, and micromachined devices, circuits, and microsystems (MEMS). It includes the Michigan Nanofabrication Facility (MNF), a state-of-the-art fabrication facility which serves nationwide researchers.

Why Use MNF?

- 30 years of experience in micro- and nano-fabrication, MEMS and compound semiconductor devices and circuits
- One of the few universities with facilities for both Si integrated circuits and compound semiconductor processing
- Extensive experience with non-traditional users

What the NNIN Brings You

- Quick start up
- All academic users pay the same rate
- Full time staff for tool support and mentoring/training of new users
- NNIN pays for technical support and training – Users only pay for lab usage
- IP belongs to user

Facilities

6,000 sq. ft. class 1000/100/10 cleanroom - Open 24/7

Dedicated areas for:

- Silicon processing (including diffusion, LPCVD)
- Compound semiconductor devices
- Thin film deposition
- Dry etching
- E-beam lithography
- Metrology
- III-V materials growth

Additional laboratories for:

- Packaging
- Testing

www.eecs.umich.edu/ssel
Research Activities

- Education and Outreach
  - K–12 Outreach: Collaboration with local high schools and middle schools
  - Seminar course on Societal Impact of Microsystems
  - College-level web-accessible courses on MEMS and Microsystems

MNIN Equipment and Processes Available to Users

Lithography/Coating
- Roth 150 4” Ultra-high resolution e-beam lithography and metrology (SEAM) tool, minimum feature ~ 50 nm
- GCA ACE 200 4/6” Fise stepper, minimum feature ~ 500 nm
- Electronika 100 4” pattern generator, minimum feature ~ 1500 nm
- EVG 501 4” double-sided contact alignment/Lithography, minimum feature ~ 2µm
- Suss MA/BA 4” double-sided contact alignment/Lithography, minimum feature ~ 1µm
- EVG6200 bond aligner, minimum feature ~ 1µm
- Suss MA/AS 45” contact alignment/Lithography, minimum feature ~ 4µm
- Suss MA/B 3” contact alignment/Lithography, minimum feature ~ 2µm
- Quantel 2000i 4” contact alignment/Lithography, minimum feature ~ 2µm
- Suss ACS-200 Coater/developer

Diffusion/Galvanization/Annealing
- Thermo 9K 4” auto-loaded high temperature furnaces, P and B diffusion and drivein
- Thermo 9K 4” auto-loaded high temperature furnaces, thermal oxide (sky and well) and gate oxides (sky gates)
- Thermo 9K 4” auto-loaded high temperature furnaces, anneal/set/reset (Cs, contacts)
- JetFirst 150 nipal thermal process tool

LPCVD
- Tempress 6000 4/6” auto-loaded conventional high-/low temperature furnaces, LTO, HTO, SiON, direct polysi, polysi, and low stress silicon nitride
- Thermo 9K 4” auto-loaded high temperature furnaces, low temperature polysi and silicas

PECVD
- Semilab dual-chamber, materials: SiN, SiO2 and e-Si
- GSI 4/8” single-chamber, materials: SiO, SiN, PSG, nitride and e-Si

PVD
- 4" e-beam evaporators (Emitech, Cooke, S20, S26) for metals (Al, Cu, Cr, Pt, Ti, In, Ni, Pd, Sn, Zn, Au), (Dielectrics (Al2O3, SiO2, SiO), (Metallic (Mo, Cr)), and semiconductors (GaAs)
- 4” quater coating (Emitech, Denton Explorer 14) for metals (Ag, Au, Cu, Cr, Co, K, Rb, Ta, Ti, Tl, Y, compounds (W/Pt), Si, Au, Si, LTO), (W/D100) and dielectrics (SiO, Si3N4, SiO2)

RIE
- Leye 6” 9000A-Cr, poly/glass etcher
- STS 4” high-density KF deep trench etcher
- Quick 4” horizontal/vertical, cluster tool, poly/glass etcher
- Plasma/PEL chambers (Technics, Applied, Semilab, PlasmaTherm), poly/glass, dielectric, TFT, polyimide, vas, wax, and PM etching

Wet Chemistry
- Cleaning (TCA, HF, Panex)
- Etching (EDP, KF3H, TMAH, HF, HF/HNO3)
- Organic / Non-oxidation processes
- Plating (Cu, Cr, Pt, Ni, Au)
- Polishing

Wafer Bonding
- DVS 501 (vacuum bond)
- Suss S902 (speed, SIC, fusion, reticule)

Metrology
- Zygo New View 5000 interferometric surface profilometer
- Spectroscanners (Zygo and Nanospec 6100) for film thickness measurement
- Derb 4A4 4” contact surface profilometer
- JEOL JSM-840 SEM with Lab and condensate
- Nikon Double Scan DME (scanning probe and optical scan)

General Utility
- Low temperature bake ovens
- Taurus 9115 CVD systems for release
- SCS Labor 600 1100 (polymer deposition systems)
- Teddington linear freezers

Wire Bond/Packaging/Test
- KKS 4712S wedge bonder
- Micro 3200A probe stations
- Solder reflow

Environmental Test
- Environmental chambers (humidity, temperature, vibration, vibration analysis, rotation table)

CAD
- Layout
- Circuit simulation

Associated Labs for Additional Capabilities

Electron Microscopy and Analysis Laboratory (EMAL)
- JEOL 2010F analytical electron microscope
- JEOL 3011 high resolution electron microscope
- FEI Quantax 200 dual beam focused ion beam workstation
- Digital Instruments scanning force microscopes (FBIA)
- Digital Instruments scanning force microscopes (SBIA)
- Perkin Elmer / PHI 5400 x–ray photoelectron spectroscopy
- FEI Nova NanoLab-dualbeam focused ion beam workstation
- Philips XL30 FEG scanning electron microscopy

Michigan Ion Beam Surface Modification and Analysis Laboratory (MIBS)
- Tandetron Accelerator 1.7MV (Rutherford backscattering spectrometry, nuclear reaction analysis, elastic recoil detection)
- Van der Waals, C1D20, 200K vacuum pump (ST20/K)
- Ion beam assisted deposition – 450 100-1200(eV)
- Vacuum furnace (up to 1200°C)
- Beamline analyzer
- Plasma Dekkert surface profiler

How to Use MNIN

1. Define your goals and needs
2. Contact Sandrine Martin (734-763-6719 or sandrine@umich.edu) to discuss your project
3. Fill in necessary forms (see MNIN website www.eecs.umich.edu/ssel)
4. Start training (online course on available on MNIN)
5. Come to Ann Arbor (remote processing is also available – limited capabilities only)
6. Complete safety and equipment training
7. Work in the lab!

Travel and Accommodations

The Michigan Nanofabrication Facility (MNIN) is part of the Electrical Engineering and Computer Science Building (ECCS), which is located on North Campus in Ann Arbor.

Ann Arbor is in Southeast Michigan, 45 miles west of Detroit, 240 miles east of Chicago, and 35 miles north of the Ohio state line. It is served by all major airlines through Detroit Metro Airport (25 miles from MNIN). Ann Arbor can also be reached from Chicago, Toledo, Cleveland, Pittsburgh by train (Amtrak) or bus (Greyhound).

NNIN Personal at MNIN

For all inquiries about the MNIN, please contact Dr. Sandrine Martin at 734-763-6719 or sandrine@umich.edu

Prof. Khali Najafi
NNIN Site Director
Prof. Fred Terry
NNIN Site Deputy Director
Betty Cummings
NNIN Administrative Manager
Dr. Dennis Grimmer
NNIN Laboratory Manager
Dr. Sandrine Martin
NNIN Site Manager

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