



# UTAH NANO FAB Tool List



## Nano-scale Imaging & Surface Analysis

(co-located MRSEC shared facilities)

- ♦ JEOL JEM-2800 S/TEM with ultrafast EDS (3D tomo) Protochips liq & gas phase ETEM / electrochemistry
- ♦ FEI Helios Nanolab 650i hi-res dbFIB, Nabity EBL Pt, W, C dep; XeF<sub>2</sub>, I<sub>2</sub>, H<sub>2</sub>O enhanced etch, EDS, EBSD
- ♦ FEI Quanta 600 FE-ESEM w/ EDS, EBSD, particle ID, MAPS
- ♦ Kratos AxisUltra imaging XPS / Auger / ISS / UPS
- ♦ EDAX Eagle III Microspot XRF (μprobe & mapping)
- ♦ Bruker ICON-PT AFM: PF-QNM, wet cell, MFM, KPFM
- ♦ Woollam V-VASE spectroscopic ellipsometer
- ♦ ZYGO NewView 5032 optical profilometer
- ♦ Micro fiducial laser cutter for correlative multiscale microscopy: 355, 532, 1064 nm; 1.2-15mJ
- ♦ Vertex 220 microVu Digital Comparator
- ♦ SEM/TEM prep tool suite, manual and ion polishing
- ♦ Hysitron TI Premier Nanoindenter system
- ♦ Olympus OLS5000 LEXT 3D measuring microscope

## Cleanroom

### DESIGN & SIMULATION SOFTWARE

- ♦ L-Edit, Cadence, AutoCAD, SolidWorks
- ♦ Link-CAD DXF/GDSII/CIF/BMP conversion tools
- ♦ SASS JMP statistical design of experiments (CADE)
- ♦ ANSYS & COMSOL finite element analysis

### LITHOGRAPHY (Class 100) *Pattern Generation & Transfer*

- ♦ Heidelberg μPG 101 Laser Pattern Generator (x2) 0.9μm, 2.5μm write heads, gray scale patterning
- ♦ Nanofrazor 30nm-200nm nanolithography tool
- ♦ EVG EV-420, Suss MA1006 front & backside mask aligner
- ♦ OAI Models 200 & 810 (with BSA) contact aligners
- ♦ SSEC 3305 Auto spin/bake HMDS/PR/EBR track
- ♦ Spinners, ovens, hot plates, hoods, SRDs
- ♦ LOR 10B, AZ 9620, Shipley 1813, nLOF 2020
- ♦ YES HMDS vapor prime vacuum oven

### THIN FILM DEPOSITION (Class 1000) *Sputtering:*

- ♦ TMV SS-40C: 8 dedicated cathodes, dual cryo-pumped
- ♦ Denton Discovery 18: 3 user config 3" cathodes, RF/DC

- ♦ Denton 635LL: 4-cathodes, RGA, OES-feedback reactive sputter, heated/cooled chuck  
*Metals/Alloys: Ag, Al, Al/Si, Au, BN, C, Chromel, Co, Cr, Cu, Cu/Ag, Ir, Ge, Fe, Ni, NiCr, NiCrFe, Nb, Pd, Pt, Ru, Si (p-type), Ta, Ti, TiW, V, W, Cr<sub>2</sub>Si, Zr, Hf*

*Oxides / Ceramics: Al<sub>2</sub>O<sub>3</sub>, AlN, SiO<sub>2</sub>, IrOx, ITO, BN, CeSm(ox), LaSrFe(ox), NaMnO<sub>3</sub>, NdMgO, SiC, Si<sub>3</sub>N<sub>4</sub>, TaO<sub>2</sub>, TiO<sub>2</sub>, YNiZrO, YSZ, ZnO, MgO*

*Evaporation: Al, Ag, Au, Au/Ge, Cr, Cu, In, Mg, Mo, NiCr, Ni, Ta, Ti*

- ♦ Denton e-beam DV-SJ/20C with 4 hearths, user configurable

### PECVD

- ♦ Oxford Plasmalab 80+: α-Si, low-stress Si<sub>3</sub>N<sub>4</sub>, SiON<sub>x</sub>, SiO<sub>2</sub>

### CVD

- ♦ SCS PDS 2010 Parylene-C

### MOCVD

- ♦ Agnitron Agilis-IH: Gallium Oxide

### ALD

- ♦ Cambridge Fiji F200 w/ thermal & plasma dep modes, H<sub>2</sub>O plasma (Pt, HfO<sub>2</sub>, ZnO, Al<sub>2</sub>O<sub>3</sub>, SiO<sub>2</sub>, TiO<sub>2</sub>, MgO, ZrO<sub>2</sub>)

### FURNACES and DIFFUSION (Class 1000) *LPCVD*

- ♦ Expertech TEOS / LTO / PSG / low-stress silicon rich and stoichiometric Si<sub>3</sub>N<sub>4</sub>, α & phosphorous-doped polySi

### *Atmospheric and Rapid Annealing*

- ♦ Allwin 610 RTP/RTA with O<sub>2</sub>, N<sub>2</sub>, Ar, H<sub>2</sub> forming gas, 200-1250C
- ♦ ProTemp wet/dry thermal silicon oxidation with DCE
- ♦ Blue-M box furnace with N<sub>2</sub> purge
- ♦ Vacuum oven (250C)

### ETCH (Class 1000)

#### *RIE and DRIE*

- ♦ STS Aspect ICP DRIE: time-multiplex Si etch (anti-footing)
- ♦ Oxford Plasmalab 100+ ICP time-multiplex & cryo DRIE SF<sub>6</sub>, CF<sub>4</sub>, CHF<sub>3</sub>, O<sub>2</sub>, Ar, N<sub>2</sub>
- ♦ Oxford Plasmalab 80+ multipurpose (SF<sub>6</sub>, CF<sub>4</sub>, O<sub>2</sub>, Ar)



# UTAH NANO FAB Tool List



- ◆ Technics PEII H<sub>2</sub>O vapor, O<sub>2</sub> descum & resist strip
- ◆ Xactix Xetch XeF<sub>2</sub> silicon isotropic etch
- ◆ Plasmatherm 790 (2X, oxide and metal etch, Cl<sub>2</sub>, BCl<sub>3</sub>)

## Wet Chemical

- ◆ Bold & WAFAB wet benches (x6) acids, bases, organics
- ◆ Gold wet-etch station

## MICROMACHINING / MESO-SCALE PROTOTYPING

- ◆ Nanoscribe Professional GT 3D nano/micro printer
- ◆ JPSA Micromachining system Ar/F<sub>2</sub> 193 nm (pending install)
- ◆ Custom KOH bulk Si etch station
- ◆ LaserStar 1900 micro laser welder (1064nm, 150J)
- ◆ CO<sub>2</sub> flatbed laser (dual laser cartridge, 25W + 75W, 1090nm)

## BACKEND PROCESSES & PACKAGING

- ◆ Strasbaugh 6EC 100 mm CMP (Si, SiO<sub>2</sub> polishing & planarizing)
- ◆ EVG 520IS wafer bonder (hot embossing, thermal & anodic)
- ◆ Disco DAD 641 & Disco 3220 dicing saws (std or UV tape)
- ◆ MEI wedge wirebonder with Au and Al wire
- ◆ TUI 9101 wire bond pull tester

## CLEAN (Class 10,000) MICROFLUIDICS

- ◆ Sylgard 184 PDMS
- ◆ SU-8 soft lithography
- ◆ Omnicure 1000 UV curing (320-500nm)
- ◆ Lamination press, spinner, vacuum oven, hotplate
- ◆ Corona discharge UV/O<sub>3</sub> plasma treatment

## CLEANROOM (Class 1000) METROLOGY

- ◆ Keyence VHX-5000 3D microscope
- ◆ n&k NKT 1500 thin film analyzer
- ◆ Nanometrics NanoSpec 3000 film thickness
- ◆ Magnetron Instruments 4-point probe
- ◆ Polyvar Met with DIC + many optical microscopes
- ◆ Tencor P-10 and P-20 stylus profilometers
- ◆ Tencor Flexus 2320 film stress analyzer

## ELECTRICAL / MAGNETIC TESTING

- ◆ Verigy 9300 SOC IC tester
- ◆ Microsense vibrating sample magnetometer (EZ-7 VSM)
- ◆ Keysight 404A Mixed Signal O-scope
- ◆ Keysight E5061B Network Analyzer
- ◆ Keithley 4200 parameter analyzer with 4 SMUs
- ◆ Micromanipulator light-tight probe station

## STAFF SERVICES

- ◆ Equipment Installation, Diagnostics, and Repair
  - FLIR
- ◆ Professional Technical Support
  - Design of Experiments (DOE)
  - R&D Process Development
- ◆ Thin Film Deposition and Patterning
- ◆ Center for Engineering Innovation [www.cei.utah.edu](http://www.cei.utah.edu)
  - Engineering design services
  - (Bio)MEMS design and fabrication
  - Advanced package development

## AFFILIATED CHARACTERIZATION LABS

- ◆ SMBB Co-located HSC Core Facility [www.cores.utah.edu/](http://www.cores.utah.edu/)
  - JEM 1400 TEM (120 keV)
  - FEI Technai T-12 TEM (120 keV), T-20 (200 keV cryo)
  - ThermoFisher Titan Krios G3 Cryo TEM
  - Olympus FV-1000 Scanning laser confocal sources: 405, 457, 488, 514, 568, 633, 748nm
- ◆ Dixon Laser Institute [www.physics.utah.edu/laser/](http://www.physics.utah.edu/laser/)
  - Witec Alpha 300 SNOM, Raman, and Confocal
  - FEI NovaNano 630 FE-SEM w/ EDS, CL and Nability EBL
- ◆ X-ray CT Lab – Michael Czabaj [m.czabaj@utah.edu](mailto:m.czabaj@utah.edu)
  - Varian BIR/150/130; GE eXplore Locus SP
- ◆ Fast-capture camera [o.kingstedt@utah.edu](mailto:o.kingstedt@utah.edu)
  - +10M fps Shimadzu Hypervision HPVX2 camera
- ◆ Nanomaterials Lab <http://nanomaterials.utah.edu>
  - Hitachi S-4800 HR-SEM / Oxford EDS (nuclear materials)
  - Micrometrics ASAP 2020 Surface Area (BET) Porosity
  - Shimadzu GCMS-QP2010; UFLC HPLC; UV-3600 UV-Vis-NIR
  - Benchtop powder XRD
- ◆ BYU: [www.chem.byu.edu/faculty/matthew-r-linford/](http://www.chem.byu.edu/faculty/matthew-r-linford/)
  - TOF-SIMS IV
- ◆ Materials Science <http://characterizationlab.mse.utah.edu>
  - Philips X'Pert XRD (also DSC, dilatometer)



# UTAH NANOFAB Tool List



- Hitachi S3000-N SEM w/ EDS & EBSD
- FT-IR (Varian 3100) & PE Lambda 950 UV/VIS
- Volatile, non-toxic deposition (ebeam and sputt)
- ◆ College of Earth Sciences (Geology & Metallurgy)
  - QEMScan 4300 ([erich.petersen@utah.edu](mailto:erich.petersen@utah.edu))
  - WDS microprobe (<http://probelab.utah.edu>)
  - ICP-MS ([diego.fernandez@utah.edu](mailto:diego.fernandez@utah.edu))
  - Bruker D8 thin film XRD [s.guruswamy@utah.edu](mailto:s.guruswamy@utah.edu)
- ◆ Energy and Geosciences Institute (<http://egi.utah.edu>)
  - QEMScan EVO 50
  - XRD mineral quantitation
  - Wet laboratories (GeoChem Lab)
- ◆ Chemistry Department [www.chem.utah.edu/facilities/](http://www.chem.utah.edu/facilities/)
  - NMR: Unity-300, Inova-400, and VXR-500
  - Single Xyl XRD; MS: TOF, Quad GC, UPLC, FTIR
  - UV-VIS-NIR, Polarimeter, scintillation, lumi, fluor

<https://ustar.org/find-us-statewide/ustar-innovation-center>

## MRSEC AFFILIATED LABS

[nanofab.utah.edu/index/about-us/affiliatedlabs](http://nanofab.utah.edu/index/about-us/affiliatedlabs)

- ◆ Organic spintronics deposition system
- ◆ Sagnac Interferometer
- ◆ Magnetic Resonance X-band cw-EPR, ENDOR, ELDOR
- ◆ (3+3)-Pass Tandem Fabry-Perot Interferometer
- ◆ THz Time-Domain Spectrometer
- ◆ UV Time-Resolved Spectroscopy

## AFFILIATED PROTOTYPE MANUFACTURING LABS

- ◆ Mechanical Engineering Shops [www.mech.utah.edu](http://www.mech.utah.edu)
  - 3D printing / rapid prototyping
  - Waterjet machining
  - All traditional machine shop tools
- ◆ Interference Lithography [photonics.ece.utah.edu](http://photonics.ece.utah.edu)
- ◆ Center for Biomedical Microfluidics  
[www.mems.utah.edu](http://www.mems.utah.edu)
  - PDMS and soft lithography
  - CO<sub>2</sub> laser micromachining
  - Knife plotter
- ◆ BioInnovationsGateway (BIG)  
[bioinnovationsgateway.org](http://bioinnovationsgateway.org)
- ◆ Center for Medical Innovation  
<http://healthsciences.utah.edu/center-for-medical-innovation/>
- ◆ USTAR North Innovation Center