UTAH NANOFAB 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_2, I_2, H_2O 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 DWL66+ Laser Pattern Generator 0.3μm (300nm) min lines and spaces, gray scale patterning
- 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, AZ 40XT, SU8, ma-P 1275
- 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 oxygen or nitrogen sputter, heated/cooled chuck to 500C, co-sputtering

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_2Si*, Zr, Hf*

Oxides / Ceramics: Al_2O_3*, AlN,* SiO_2*, IrOx, ITO, BN, CeSm(ox), LaSrFe(ox),* $NaMnO_3$*, NdMgO, SiC,* Si_3N_4*,* TaO_2*,* TiO_2*, 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_3N_4, $SiON_x$, SiO_2

CVD

- SCS PDS 2010 Parylene-C

MOCVD

- Agnitron Agilis-IH: Gallium Oxide

ALD

- Cambridge Fiji F200 w/ thermal & plasma dep modes, H_2O plasma (Pt, HfO_2, ZnO, Al_2O_3, SiO_2, TiO_2, MgO, ZrO_2)

FURNACES and DIFFUSION (Class 1000) *LPCVD*

- Expertech TEOS / LTO / PSG / low-stress silicon rich and stoichiometric Si_3N_4, α & phosphorous-doped polySi

Atmospheric and Rapid Annealing

- Allwin 610 RTP/RTA with O_2, N_2, Ar, H_2 forming gas, 200-1250C
- ProTemp wet/dry thermal silicon oxidation with DCE
- Blue-M box furnace with N_2 purge
- Vacuum oven (250C)

UTAH NANOFAB Tool List

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_6, CF_4, CHF_3, O_2, Ar, N_2
- Oxford Plasmalab 80+ multipurpose (SF_6, CF_4, O_2, Ar)
- Technics PEII H_2O vapor, O_2 descum & resist strip
- Xactix Xetch XeF_2 silicon isotropic etch
- Plasmatherm 790 (2X, oxide and metal etch, Cl_2, BCl_3)

Wet Chemical

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

MICROMACHINING / MESO-SCALE PROTOTYPING

- Nanoscribe Professional GT-2 3D nano/micro printer
- JPSA Micromachining system Ar/F_2 193 nm (pending install)
- Custom KOH bulk Si etch station
- LaserStar 1900 micro laser welder (1064nm, 150J)
- CO_2 flatbed laser (dual laser cartridge, 25W + 75W, 1090nm)

BACKEND PROCESSES & PACKAGING

- Strasbaugh 6EC 100 mm CMP (Si, SiO_2 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_3 plasma treatment

CLEANROOM (Class 1000) METROLOGY

- Keyence VHX-5000 3D microscope
- n&k NKT 1500 thin film analyzer with wafer mapping
- Nanometrics NanoSpec 3000 film thickness
- Filmetrics F20 & F40 small spot film thickness and refractive index
- 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
  - Engineering design services
  - (Bio)MEMS design and fabrication
  - Advanced package development

AFFILIATED CHARACTERIZATION LABS

- SMBB Co-located HSC Core Facility 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/
  - Witec Alpha 300 SNOM, Raman, and Confocal
  - FEI NovaNano 630 FE-SEM w/ EDS, CL and Nabity EBL
- X-ray CT Lab – Michael Czabaj m.czabaj@utah.edu
  - Varian BIR/150/130; GE eXplore Locus SP
- Fast-capture camera o.kingstedt@utah.edu
  - +10M fps Shimadzu Hypervision HPVX2 camera

UTAH NANOFAB Tool List

- 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/
  - TOF-SIMS IV
- Materials Science http://characterizationlab.mse.utah.edu
  - Philips X'Pert XRD (also DSC, dilatometer)
  - 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)
  - WDS microprobe (http://probelab.utah.edu)
  - ICP-MS (diego.fernandez@utah.edu)
  - Bruker D8 thin film XRD 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/
  - NMR: Unity-300, Inova-400, and VXR-500
  - Single Xyl XRD; MS: TOF, Quad GC, UPLC, FTIR
  - UV-VIS-NIR, Polarimeter, scintillation, lumi, fluor

MRSEC AFFILIATED LABS
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
  - 3D printing / rapid prototyping
  - Waterjet machining
  - All traditional machine shop tools

- Interference Lithography photonics.ece.utah.edu
- Center for Biomedical Microfluidics www.mems.utah.edu
  - PDMS and soft lithography
  - CO_2 laser micromachining
  - Knife plotter
- BioInnovationsGateway (BIG) bioinnovationsgateway.org
- Center for Medical Innovation http://healthsciences.utah.edu/center-for-medical-innovation/
- USTAR North Innovation Center https://ustar.org/find-us-statewide/ustar-innovation-center