UTAH NANOFAB Tool List

Nano-scale EM Imaging & Surface Analysis

https://emsal.nanofab.utah.edu/

ELECTRON MICROSCOPES

- STEM: JEOL JEM-2800 with ultrafast EDS (3D tomo) Protochips liq & gas phase ETEM / electrochemistry
- dbFIB: FEI Helios Nanolab 650i hi-res, Nabity EBL Pt, W, C dep; XeF_2, I_2, H_2O enhanced etch, EDS, EBSD
- SEM: FEI Quanta 600 FE-ESEM w/ EDS, EBSD, particle ID, MAPS, Bruker PI-89 Picoindenter stage
- SEM: FEI Teneo FE-SEM w/ EDS, EBSD, Trinity™ imaging detectors
- SEM: JEOL IT200LV (W-filament SEM) – cleanroom inspection microscope

MATERIALS CHARACTERIZATION: (COMPOSITION, STRUCTURE, MECHANICAL, OPTICAL, MAGNETIC, ELECTRICAL)

- ***New!*** – nanoCT: Zeiss Xradia 620 Versa 4D non-destructive imaging, 600nm resolution, in-situ (heating/cooling/tension/compression)
- ***New!*** – XRD (Hi-Res): Bruker Discover D8, thin film/powder/crystalline/polycrystalline samples, XRR, RSM, rocking curves, θ/2θ, 1100º heating stage
- ***New!*** Cathodoluminescence (CL) detector (Teneo SEM): Gatan Monarc Pro hyperspectral imaging
- ***New!*** LC-MS/MS: Agilent 6470B, m/z 5 – 3000, 0.7 Da resolution
- SAXS/WAXS/GISAXS: Anton Paar SAXSPoint 5.0 with in situ heating/cooling/mechanical loading/humidity
- DLS: Anton Paar Litesizer 500 with Zeta potential
- XRF: EDAX Eagle III Microspot (μprobe & mapping)
- Nanoindenter: Hysitron TI Premier with heating stage
- Picoindenter: stage for SEM, Hysitron PI89
- Magnetometer: Microsense vibrating sample magnetometer (EZ-7 VSM)
- Potentiostat: Gamry Reference 600+

SURFACE ANALYSIS

- XPS/AES/ISS/UPS: Kratos AxisUltra
- AFM: Bruker ICON-PT with PF-QNM, wet cell, MFM, KPFM
- Ellipsometer: Woollam V-VASE spectroscopic

OPTICAL MICROSCOPES AND PROFILERS

- Olympus OLS5000 LEXT 3D measuring laser microscope
- Keyence VHX1 3D measuring microscope
- Vertex 220 microVu Digital Comparator
- Optical Microscope: Reichert MeF_3 with BF, DF, DIC

SAMPLE PREPARATION (COATING, POLISHING, ION-POLISHING, PLASMA CLEANING)

- Micro fiducial laser cutter for correlative multiscale microscopy: 355, 532, 1064 nm; 1.2-15mJ
- Sample Coating for SEM imaging (Au/Pd, C, Cr): Gatan PECS I, Leica ACE600
- Mechanical polishing: SEM/TEM prep tool suite
- Ion polishing: Fischione 1060, Gatan PECS I and II
- Plasma Cleaner for TEM samples: Fischione 1020

Cleanroom Micro and Nanofabrication

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LITHOGRAPHY (Class 100) *Pattern Generation & Direct Write*

- ***Coming Soon!*** Raith Voyager EBL electron beam lithography tool. 8nm min feature size. Chips to 200mm wafers. Stitch-free modes for arrays and vector writing.
- Nanoscribe Professional GT-2 micro/nano 3D printer: 200nm-μm-mm scale printing on silicon and glass. IP-DIP, IP-S, IP-Q, IP-Visio, IP-PDMS, GP-Silica, IP-n162 Resins
- Heidelberg DWL66+ Laser Pattern Generator submicron 0.3μm (300nm) min lines and spaces, gray-scale patterning, direct write up to 200mm substrates and 9" photomasks.
- Heidelberg μPG 101 Laser Pattern Generator (x2) 0.9μm, 2.5μm write heads, gray scale lithography
- Nanofrazor 30nm-200nm nanolithography tool
- EVG EV-420, Suss MA1006 front & backside mask aligner
- OAI Models 200 & 810 (with BSA) contact aligners
- Spinners, ovens, hot plates, fume hoods, SRDs, ultrasonic lift-off. CEE Apogee spinner/bakeplate.
- LOR 10B, AZ 10XT, Shipley 1813, nLOF 2020, AZ 40XT, SU8, ma-P 1275, AZ Barlii II ARC, AZ MiR 701, HMDS
- L-Edit, Cadence, AutoCAD, SolidWorks
- Link-CAD DXF/GDSII/CIF/BMP conversion tools

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/Reactive/Heated sputtering.

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- Denton 635LL: 4-cathodes, RGA, OES-feedback reactive O_2 or N_2 sputter, heated/cooled chuck to 500°C, co-sputtering, coats up to 200mm dia wafers

Precious Metals: Ag, Au, Ir, Pd, Pt, Ru
Other Metals/Alloys: Al, Al/Si, BN, C, Chromel, Co, Cr, Cu, Cu/Ag, Ge, Fe, Ni, NiCr, NiCrFe, Nb, Si (p-type), Ta, Ti, TiW, V, W, Cr_2Si, Zr, Hf
Oxides / Ceramics: Al_2O_3, AlN, SiO_2, IrOx, ITO, BN, YSZ
Evaporation: Al, Ag, Au, Au/Ge, Cr, Cu, Mo, NiCr, Ni, Ta, Ti

- Denton e-beam DV-SJ/20C with four hearths

PECVD

- ***New!*** Oxford PlasmaPro 100 Cobra 300 ICP: Si_3N_4, SiO_2, amorphous Si, coats pieces up to 200mm wafers

CVD

- SCS PDS 2010 Parylene-C

MOCVD

- Agnitron Agilis-IH: Gallium Oxide, Germanium Oxide

ALD

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

FURNACES and DIFFUSION (Class 1000)

LPCVD

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

Atmospheric and Rapid Annealing

- Allwin 610 RTP/RTA with O_2, N_2, Ar, H_2 forming gas, 200-1250°C. Pieces to 150mm wafers.
- ProTemp wet/dry thermal silicon oxidation with DCE
- Blue-M box furnace with N_2 or Ar purge (1100 °C)
- Vacuum oven (250 °C)

ETCH (Class 1000)

RIE and DRIE

- Oxford Plasmalab 100+ ICP DRIE Bosch & cryo, SF_6, CF_4, CHF_3, O_2, Ar, N_2
- ***New!*** Oxford PlasmaPro 100 Cobra 300 ICP DRIE: etches pieces up to 200mm wafers
- Technics PEII H_2O vapor, O_2 descum & resist strip
- Xactix Xetch XeF_2 silicon isotropic dry etch
- Plasmatherm 790 metal RIE (Cl_2, BCl_3, SF6, CF4, O2, Ar)

Wet Chemical

- Wet benches & SRDs (x7) acids, bases, develop
- Solvent hoods (x8): liftoff lithography, strip, clean
- Gold wet-etch station

MICROMACHINING / MESO-SCALE PROTOTYPING

- KOH bulk Si micromachining etch station
- ULS CO_2 flatbed laser (25W + 75W, 1090nm)
- DPSS Samurai UV laser (355nm, 10um spot size, 3 W)

PACKAGING, ASSEMBLY, and BACKEND PROCESSES

- EVG 520IS wafer bonder (anodic, eutectic, polymer, fusion)
- Disco DAD 641 & Disco 3220 dicing saws (std or UV tape)
- MEI wedge wirebonder with Au and Al wire
- LPKF S104 PCB milling system
- LPKF Contac S4 PCB through-hole plating system
- LPKF Protoflow S4 solder reflow oven
- CHM-550 SMT Pick and place machine

CLEAN (Class 10,000) MICROFLUIDICS

- SU-8 soft lithography and Sylgard 184 PDMS bonding
- Corona discharge UV/O_3 plasma treatment

CLEANROOM (Class 1000) METROLOGY AND TESTING

- Keyence VHX-5000 & VHX1 3D measuring microscopes
- n&k NKT 1500 thin film analyzer with wafer mapping
- Nanometrics NanoSpec 3000 film thickness
- Filmetrics F20 & F40 small spot film thickness
- Magnetron Instruments 4-point probe
- Polyvar Met with DIC + many optical microscopes
- Tencor P-10, P-20, & Alphascan D600 stylus profilometers
- Tencor Flexus 2320 film stress analyzer
- Verigy 9300 SOC IC tester
- Keithley 4200A semiconductor parameter analyzer (four SMUs + Micromanipulator probe station

CLEANROOM STAFF SERVICES

- Sign up to use the Nanofab: https://www.nanofab.utah.edu/get-access-to-our-lab/
- Professional technical support
  - 3D microprinting on Nanoscribe GT2 Pro
  - Photomask design and generation
  - Wafer/chip design and fabrication (up to 200mm)
    - Microfluidics
    - Microoptics (lenses, diffractive optical elements)
    - MEMS and microactuators
    - Microsensors and Multi-electrode arrays
- Thin film deposition, lithography, and patterning