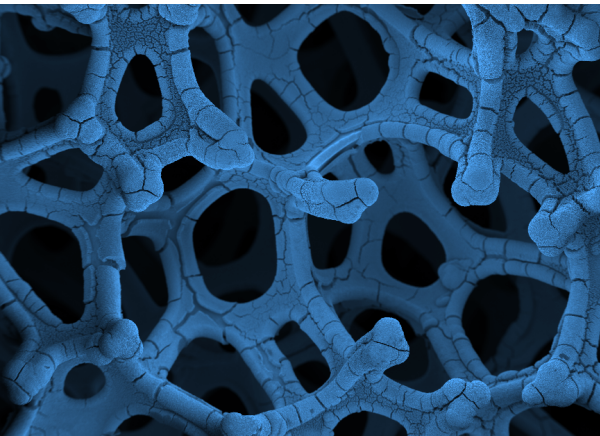


THE
nanoFAB

UNIVERSITY OF ALBERTA

Fabrication | Characterization | Expertise





An environment designed for success

The nanoFAB is a centralized, open-access, training, service, and collaboration facility, focused on academic research and industrial applications in micro- and nanoscale fabrication and characterization. Our vision is to be the best research facility available to our diverse user community.

Established in 1999, the nanoFAB totals \$110M in specialized equipment and infrastructure across 20 000 square feet of communal laboratory space—including a 5000 square foot, class 100 cleanroom—available to academic researchers, students, and industry. With over 190 tools available for training and independent use, the nanoFAB provides complete capabilities for lithography, thin film deposition, etching, microscopy, spectroscopy, and materials analysis, catering to a wide variety of applications.

The nanoFAB also collaborates with academics and industry in the development of new processes and techniques, which can enhance our capabilities and offerings to our user community. Through our fee-for-service model, our expertise can be further leveraged, catering to your fabrication and characterization needs.



FACULTY OF
ENGINEERING

Faculty of

SCIENCE

University of Alberta

ADVANCED LITHOGRAPHY

Dedicated 1000 sq ft vibration-isolated lithography room for UV, DUV, electron-beam, and laser writing capabilities.

CONTACT MASK ALIGNERS (6" COMPATIBILITY)

- ▶ General-purpose UV exposures
H-line (405 nm) / I-line (365 nm)
- ▶ IR/optical backside alignment
- ▶ Deep-UV exposures (220 nm / 254 nm)
- ▶ Semi-automated alignment
- ▶ Positive/negative tone resist chemistries

HEIDELBERG DWL PATTERN GENERATOR

- ▶ Produces 5" & 7" photomasks
- ▶ 1 μm minimum feature size
- ▶ Full-service processing with online mask submission
- ▶ Direct-write laser lithography

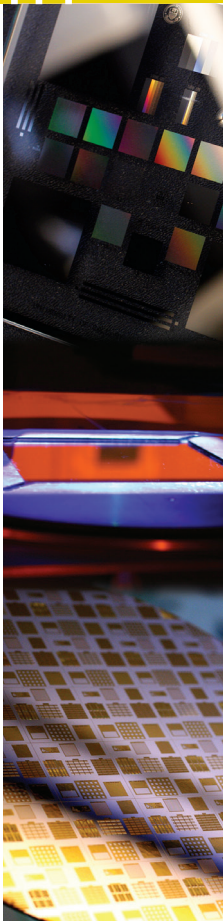
EXTENSIVE WET CHEMICAL PROCESSING AREA AVAILABLE

RAITH150 TWO ELECTRON-BEAM LITHOGRAPHY SYSTEM

- ▶ Schottky field emission gun (0.2–30 kV)
- ▶ Interferometric laser stage for stitching
- ▶ <10 nm minimum feature size
- ▶ FBMS mode enables full-wafer processing

ZEISS ORION NANO FAB HELIUM-ION MICROSCOPE WITH GALLIUM FIB

- ▶ He beam for milling delicate sub-10 nm nanostructures (nanomachining)
- ▶ Ga FIB for bulk micromachining
- ▶ Patterning and imaging controlled using Fibics NPVE system



Fabrication

THIN FILM DEPOSITION

MAGNETRON PLASMA SPUTTERING

- ▶ Four-substrate, three-gun, sequential sputtering general-purpose chamber
- ▶ Single-substrate, pulsed DC power supply with RF back etch
- ▶ Co- and reactive (O_2/N_2) sputtering
- ▶ Four-gun, load-locked, automated, single-substrate system with RF back etch

ELECTRON-BEAM EVAPORATION

- ▶ Single-substrate, four-pocket system for deposition of metals and dielectrics
- ▶ Two glancing-angle deposition (GLAD) systems for nanostructured thin films (automated substrate tilt and rotation)

LOW-PRESSURE CHEMICAL VAPOUR DEPOSITION

- ▶ Automated batch processing system
- ▶ Deposition of low-stress nitride, stoichiometric nitride, poly-Si, amorphous Si, and boron-doped poly-Si on 4" and 6" wafers
- ▶ Annealing furnaces (up to 1050 °C)

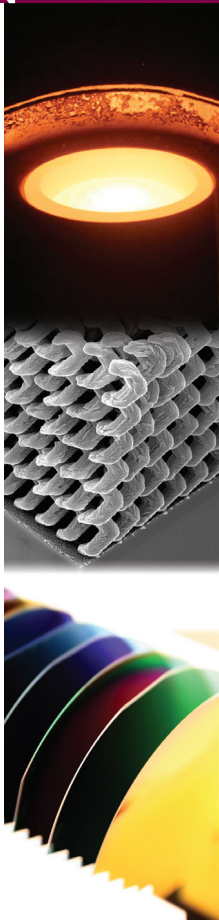
THERMAL OXIDATION

- ▶ Wet and dry oxidation of Si for high-quality oxide growth on 4" and 6" wafers
- ▶ General-purpose anneal (up to 1050 °C)
- ▶ Rapid thermal processing/annealing

PLASMA-ENHANCED CHEMICAL VAPOUR DEPOSITION

- ▶ SiO_2 , SiO_xN_y , and SiN_x deposition
- ▶ Tunable stoichiometry and film stress
- ▶ Substrates: small pieces up to 6" wafers

THERMAL ORGANIC EVAPORATOR



PLASMA ETCH

ICP/RIE SILICON PLASMA ETCH SYSTEM – OXFORD ESTRELAS

- ▀ Dedicated Bosch and Cryo processing
- ▀ Nanometre to through-wafer etching
- ▀ Plasma dicing for die singulation of arbitrary shapes and layouts
- ▀ Profile, depth, and sidewall roughness control on 4" and 6" wafers
- ▀ Optical endpoint detection

ICP/RIE DIELECTRIC PLASMA ETCH SYSTEM – ALCATEL AMS110

- ▀ Deep-etch system for quartz, glass, other dielectric materials, and silicon
- ▀ In-house process recipes for nanometre to deep etching with vertical profiles

ICP/RIE METAL PLASMA ETCH SYSTEM – OXFORD COBRA

- ▀ Dedicated metal and III-V etching
- ▀ Cl_2 , BCl_3 , HBr , SF_6 , CHF_3 , Ar , and O_2 etch chemistries
- ▀ Optical endpoint detection
- ▀ Tooled for 4" and 6" wafers

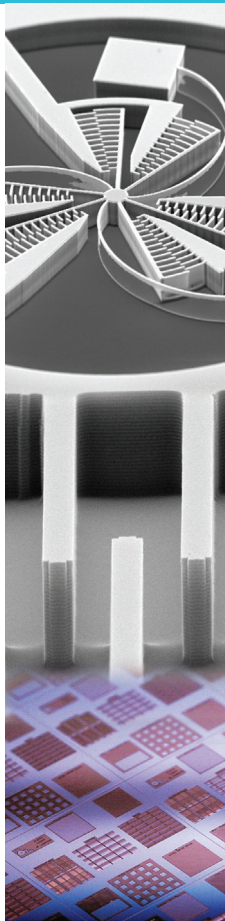
TRION RIE AND OXFORD NGP80

- ▀ Dedicated SiO_2 and SiN_x etching
- ▀ Substrates: small pieces up to 6" wafers

DRY RELEASE ETCHING

- ▀ XeF_2 for gas-phase isotropic etching of Si
- ▀ Vapour HF for etching SiO_2
- ▀ Dry etch release for MEMS

SURFACE ACTIVATION, DESCUM, O_2 PLASMA POST-CLEANING AVAILABLE



MATERIALS ANALYSIS

DISCOVERY/THERMO SCIENTIFIC TGA-FTIR

- ▶ Thermogravimetric analysis (specimen mass vs. temperature), with FTIR for evolved gas analysis
- ▶ Analysis from ambient up to 1000 °C
- ▶ Process gases: air, N₂, CO₂

AUTOSORB IQ

- ▶ Flexible and versatile surface area and pore size analysis
- ▶ Micropore, mesopore, and macropore analysis by physi- or chemisorption

DIFFERENTIAL SCANNING CALORIMETER

- ▶ Measures temperatures and heat flows associated with thermal transitions
- ▶ Used to quantify glass transitions, phase changes, crystallization, product stability, cure/cure kinetics, and oxidative stability

BIOMATERIALS ANALYSIS

MALDI-MS

- ▶ Mass spectroscopy on large biomolecules

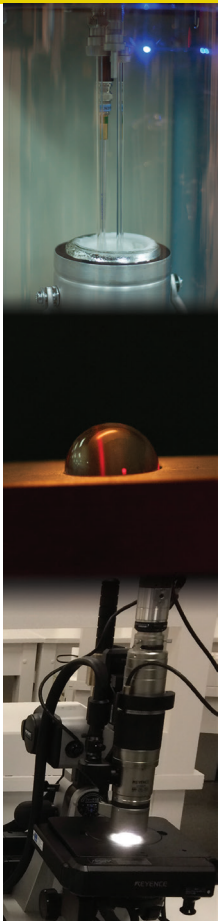
BD CALIBUR FLOW CYTOMETER

- ▶ Used to count and sort cells and organelles through fluorescent tags

Q-TRAP MS WITH UPLC

- ▶ Mass spectroscopy with liquid specimens
- ▶ High sensitivity, accuracy, and throughput

MEMS DEVICE PROBE STATIONS, UV-VIS SPECTROPHOTOMETER, VARIABLE-ANGLE SPECTROSCOPIC ELLIPSOMETER, OPTICAL PROFILOMETER, CONTACT ANGLE GONIOMETER



Characterization

SURFACE SPECTROSCOPY

JEOL-9500 AUGER MICROPROBE/FESEM

- 2D and 3D elemental distributions on surfaces with high spatial resolution
- Auger spectrometer and Oxford EDX
- Mapping and depth profiling

IONTOF SIMS IMAGING SPECTROMETER

- Elemental and molecular information about surfaces, thin layers, and interfaces (2D maps and depth profiling)
- Very high surface sensitivity
- Detector mass range: from 1 (H) to several thousand amu
- Pulsed low-energy (20 eV) electron flood gun for use with insulating specimens

KRATOS AXIS 165 XPS SPECTROMETER

- Semi-quantitative compositional and chemical state information
- Handles powders and solid specimens
- Depth profiling with Ar⁺ sputtering
- Low-temperature capability to -150 °C
- In-situ catalysis cell attached to the XPS analytical chamber

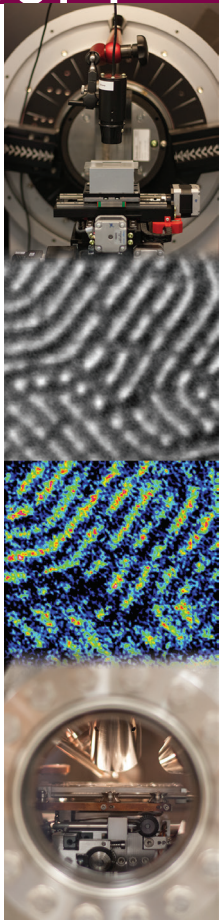
X-RAY DIFFRACTION

BRUKER D8 XRD

- High resolution diffraction
- Stage heating: ambient to 900 °C
- Quantitative phase analysis
- 2-dimensional XRD2 capabilities

RIGAKU XRD ULTIMATE IV

- Thin-film and bulk XRD
- Multiple-sample stage
- Automatic alignment capability



ADVANCED MICROSCOPY

ZEISS ORION NANO FAB HELIUM-ION MICROSCOPE WITH GALLIUM FIB

- ▶ High surface sensitivity imaging
- ▶ Ultra-high resolution imaging (0.5 nm)
- ▶ Direct imaging of insulating materials
- ▶ 3D tomography

TRANSMISSION ELECTRON MICROSCOPES

JEOL JEM-ARM200CF

- ▶ Cold FEG emitter
- ▶ 200, 80, and 60 kV acceleration voltage
- ▶ <0.1 nm resolution (HAADF STEM)
- ▶ Large-angle SDD-EDX detector
- ▶ 3D tomography

PHILIPS CM20

- ▶ 200 kV acceleration voltage
- ▶ <0.3 nm resolution
- ▶ EDX detector for elemental analysis

SCANNING ELECTRON MICROSCOPES

ZEISS SIGMA FESEM

- ▶ Schottky field emitter
- ▶ 100 V to 30 kV acceleration voltage
- ▶ Excellent low-voltage imaging
- ▶ GEMINI® column (electrostatic lens) for imaging magnetic materials
- ▶ Detectors: In-lens SE, SE, BSD, 150 mm² SDD-EDX, EBSD

ZEISS EVO AND TESCAN VEGA-3

- ▶ General-purpose, thermal emission SEMs
- ▶ EDX detector for elemental mapping

OPTICAL AND ATOMIC-FORCE MICROSCOPES

