CEDT Equipment List: Compound Semiconductor Lab

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Compound Semiconductor Lab – TAB 110, TAB 205

Atomic Layer Deposition System - PEALD (Arradiance GEMStar XT-DP)

TAB 110

Description:

- Benchtop plasma-enhanced atomic layer deposition (PEALD) system for ultrathin conformal film growth and surface engineering applications. Supports conformal dielectric thin-film deposition including SiO_2 and Al_2O_3 plasma-assisted processing, pulsed precursor delivery, and mass flow-controlled gas handling.
- Applications: dielectric thin-film deposition, semiconductor surface passivation, waveguide cladding, surface modification

Details:

- RF plasma source: 300 W air-cooled direct inductively coupled plasma (ICP) system
- Reactor temperature: adjustable up to 300°C
- Substrate size: up to 200 mm diameter
- Manifold configuration: two heated manifold zones operating up to 200°C
- ALD precursor delivery: eight high-speed ALD valve ports including one pulsed vapour push (PVP) channel
- Carrier gas control: user-selectable carrier gas with MFC-regulated flow up to 200 SCCM
- Precursors : TMA (for Al_2O_3), BTBAS(for SiO_2)

Dicing Saw (Disco DAD3221)

TAB 205

Description:

- Precision semiconductor dicing saw for cutting wafers, dies, and brittle substrates including semiconductor materials, glass, and ceramics. Supports manual operation or fully automated alignment and cutting workflows using integrated image-processing software.

Details:

- Wafer size: 2"–6" diameter
- Substrate size: up to 160 mm diameter and 500 mm thickness
- Motor power: 2000 W synchronous spindle
- Motor speed: 3,000–40,000 rpm
- Cut positioning resolution: 0.1 µm step increments
- Cutting speed: up to 100 mm/s
- Optical alignment system: 7.5× magnification CCD imaging system
- Optical field of view: 0.64 mm
- Operational modes: manual and fully automated programmable cutting
- Blade compatibility: installed for cleaving of Si and LiNbO3 but configurable for multiple blade types

Femtosecond Laser Manufacturing System (FEMTIKA)

TAB 110

Description:

- Hybrid femtosecond laser microfabrication platform supporting multiphoton polymerization, selective laser etching, and laser ablation processes. Integrates automatic beam alignment, real-time optical monitoring, vibration isolation, and nanoscale positioning for high-precision additive and subtractive manufacturing of polymeric, glass, and crystalline materials.

Details:

- Compatible materials: materials with refractive index $n = 1.45$ such as fused silica and the polymers SZ2080 PI: Irgacure 369 (1%) and SZ2080 PI: 4,4-Bis(diethyamino)benzophenone (0.5%)
- Fabrication resolution: down to 200 nm
- Laser wavelengths: 1030 nm and 515 nm
- Travel range: 160 × 60 × 60 mm
- Nanopositioning accuracy: ±300 nm (XY), ±275 nm (Z)
- Positioning resolution: 1 nm (XY), 2 nm (Z)
- Sample stage load capacity: >5 kg
- Sample holder configuration: vacuum-sealed holder with computer-controlled illumination
- Illuminated working area: 14 × 66 mm

Fume Hood (Design Filtration TXH-5)

Description:

- Total exhaust 5 ft wide laminar flow hood providing ISO Class 5 (formerly Class 100) cleanliness conditions via a self-contained HEPA fan filter module. Features a vertical-rising face shield and sealed LED light fixture.
- 2 in Cleanroom, 3 in Organic Lab

Hall Effect Measurement System (Nanometrics HL5500PC)

TAB 110

Description:

- Turnkey Hall effect characterization system for electrical measurement of semiconductor materials, including sheet resistivity, carrier concentration, and carrier mobility across a broad resistivity and temperature range.

Details:

- Magnetic field source: 0.5 T permanent magnet
- Standard sheet resistivity: up to ~10 MΩ/square
- Extended sheet resistivity: up to 100 GΩ/square with high-impedance buffer amplifier
- Measurable Hall voltage: down to ~10 µV
- Source current capability: down to 1 pA with high-impedance amplifier
- Temperature measurement range: 90–550 K
- Compatible sample geometries: Van der Pauw, bar, and bridge structures
- Recommended sample size: ~1 × 1 cm to 1.5 × 1.5 cm, up to 1 mm thick

Ion Implanter (Whickham M50 Series)

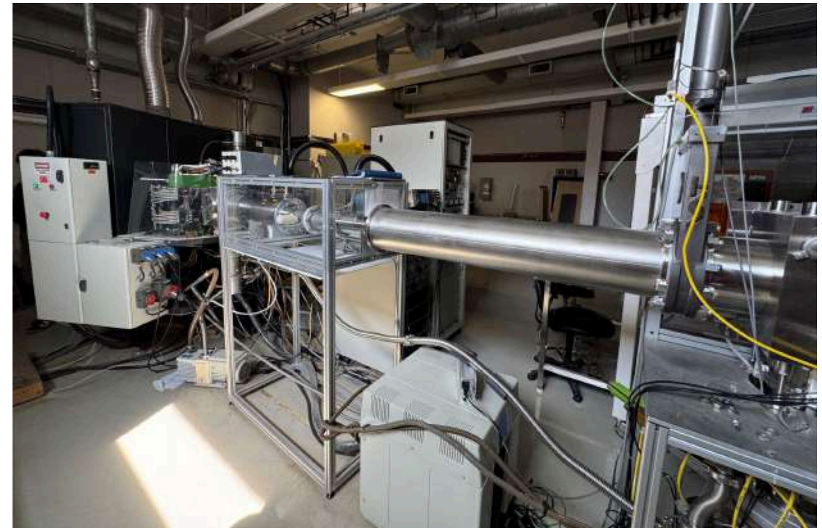
TAB 110

Description:

- Ion implantation system capable of generating, mass-selecting, and accelerating a broad range of ion species for semiconductor doping and materials modification applications. Supports multiple ion source configurations, high beam stability, and mass resolution suitable for semiconductor process development.
- Applications: semiconductor doping, ion beam modification, implantation process development

Details:

- Beam energy range: 5–200 keV
- Accelerator configuration: source acceleration up to 50 kV with post-acceleration up to 160 kV
- Beam current capability: >1 mA for all elements; >10 mA for selected species including As and P
- Mass range: up to 250 amu with resolution $M/\Delta M > 1000$
- Magnet resolution: >1000
- Beam energy stability: 1 part in 10^4
- Source temperature: gas source 250–600°C; sputter source 400–1000°C
- Filament lifetime: up to 40 h depending on species and operating conditions
- Beam sweep system: 50 Hz modulation with 50 kV extraction



Metal Organic Chemical Vapour Deposition System (SMI EPIC MOCVD)

TAB 205

Description:

- Metal organic chemical vapour deposition (MOCVD) system for epitaxial growth of high-purity crystalline compound semiconductor thin films. Utilizes hydrogen-rich processing environments, independently controlled heating zones, and precision gas flow control for advanced III-V semiconductor growth.
- Applications (current/recent projects): (In, Ga)As quantum dots (1.3 µm lasers, quantum photonics), III-V (GaAs, InP, GaP) direct growth on Si, Sb surfactant, multi-junction photovoltaics

Details:

- Group III precursors: trimethyl- aluminum (TM-Al), gallium (TM-Ga), indium (TM-In); triethyl-gallium (TE-Ga)
- Group V precursors: phosphine, arsine, trimethyl-antimony (TM-Sb)
- Dopants: silane, diethyl-tellurium (DE-Te) [n-type]; diethyl zinc (DE-Zn) [p-type]
- Substrate formats: 3" × 2", 1" × 4", and diced pieces
- Substrate temperature: up to ~1100°C

Molecular Beam Epitaxy System - Gas Source MBE (SVT Associates)**

TAB 110

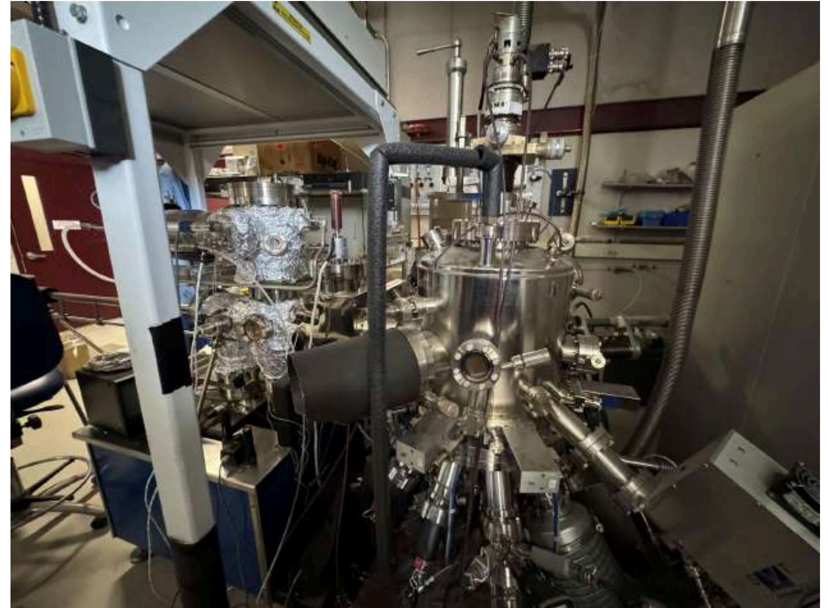
Description:

- Ultra-high vacuum molecular beam epitaxy (MBE) system utilizing thermally cracked gas precursors and solid evaporation sources for epitaxial growth of high-purity semiconductor thin films with atomic-scale thickness control.
- Applications (current/recent projects): III-V nanowires (photodetectors, biosensors), InP- and GaAs-based laser growth, (In,Ga)As quantum dots, InSb, surfactant-enhanced epitaxy (Bi, Sb)

Details:

- Group III sources: Al, Ga, In
- Group V sources: phosphine, arsine, Sb, Bi
- Dopants: Te, Si [n-type]; Be [p-type]
- Plasma source: H2
- Supported materials: III-V semiconductors, II-VI semiconductors, nitrides, and oxide thin films
- Substrate formats: 1" × 3", 1" × 2", and diced piece

**This equipment is not currently in use. For inquiries, please contact the CEDT at cedt@mcmaster.ca



Parylene Coating System (Specialty Coating Systems Labcoter® 2)

TAB 110

Description:

- Conformal parylene coating deposition system designed for uniform polymer encapsulation and surface protection of electronic, biomedical, and MEMS devices.
- Applications: circuit boards, sensors, wafers, medical devices, MEMS, elastomeric components

Details:

- Chamber dimensions: 12" × 12" (30.5 × 30.5 cm)
- Chamber capacity: ~22 L
- Dimer capacity: up to 125 g (0.28 lb)

Rapid Thermal Annealing System - III-V (JIPELEC JETFIRST 100)

TAB 205

Description:

- Benchtop rapid thermal processing (RTP) system utilizing a cold-wall process chamber and multizone halogen lamp furnace for rapid thermal annealing of III-V semiconductor substrates. Integrated PIMS PC control software provides process monitoring, data acquisition, and pyrometer calibration across a broad temperature range.

Details:

- Substrate size: up to 100 mm (4") diameter
- Process temperature: up to 1250°C
- Temperature monitoring: thermocouple feedback control
- Control software: PIMS PC-based process monitoring and data acquisition
- Compressed air requirement: 6 bar
- Cooling/utility flow requirement: 300 L/min
- Electrical requirements: 80 A, 30 kW, 60 Hz
- Annual throughput capacity: up to 5000 wafers/year

Rapid Thermal Annealing System - Si (JIPELEC JETFIRST 100)

TAB 205

Description:

- Benchtop rapid thermal processing (RTP) system utilizing a cold-wall process chamber and multizone halogen lamp furnace for rapid thermal annealing of Si-based semiconductor substrates. Integrated PIMS PC control software supports thermal process monitoring, data acquisition, and pyrometer calibration.

Details:

- Substrate size: up to 100 mm (4") diameter
- Process temperature: up to 1250°C
- Temperature monitoring: thermocouple feedback control
- Control software: PIMS PC-based process monitoring and data acquisition
- Compressed air requirement: 6 bar
- Cooling/utility flow requirement: 300 L/min
- Electrical requirements: 80 A, 30 kW, 60 Hz
- Annual throughput capacity: up to 5000 wafers/year

Roll-to-Roll Magnetron Sputtering System (Angstrom Engineering)

TAB 110

Description:

- Custom roll-to-roll magnetron sputtering platform designed for continuous deposition of uniform thin films onto flexible substrates. Supports reactive sputtering, RF substrate biasing, automated process recipes, and *in situ* optical monitoring for precision thin-film engineering.

Details:

- Sputtering sources: four DC magnetrons and two RF magnetrons
- Compatible target materials: Au, Cu, ITO, SiO_2, Ni, Ti, Cr
- Target size: up to 4” diameter
- Substrate heating capability: up to 500°C
- Substrate rotation: up to 30 rpm for enhanced thickness uniformity
- RF substrate biasing: supported for pretreatment and plasma cleaning operations
- Programmable automated deposition recipe library

Tube Furnace System (Lindberg/Blue M STF55666 Series Moldatherm)

TAB 205

Description:

- Multi-zone tube furnace system designed for controlled thermal processing, annealing, and high-temperature material synthesis. Features double-shell insulated construction and independently programmable PID-controlled heating zones for stable thermal processing conditions.

Details:

- Temperature: 100–1100°C
- Three independently controlled heating zones
- Control system: microprocessor-based self-tuning PID controllers
- Thermal insulation: double-shell construction with variable-density insulation
- Power consumption: 11 kW
- Applications: annealing, diffusion studies, oxidation, materials synthesis, and thermal treatment processes