

## Centre for Advanced Photovoltaic Devices and Systems (CAPDS)

<http://www.capds.uwaterloo.ca/>

CAPDS promotes cutting-edge research and development that spans the spectrum of photovoltaic (PV) technology. Our 14,000-square-foot facility includes infrastructure for synthesizing semiconductor base materials; developing nanotechnologies for PV; designing and fabricating advanced PV devices and modules; and testing and characterizing PV materials, devices and systems.

### Location

ERC 1st floor

### Management

Director:

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### Users

- Faculty Collaborators (Electrical and Computer Engineering; Mechanical and Mechatronics Engineering; Chemistry)
- Collaborative R&D projects with other universities:
  - University of Toronto
  - McMaster University
  - University of Western Ontario
  - Concordia University

### Research

- Silicon Crystal Growth
- Non-planar Crystal Techniques
- Semiconductor Material Improvement
- Thin-film Semiconductor Materials
- Device Design
- Photovoltaic Device Technology
- Semiconductor Nanostructures and Quantum Dots
- Structural and Optical Properties Nanostructures
- Nano Photovoltaics
- Health and Safety of PV technologies
- Photovoltaic Modules
- Back-end Power Conditioning

## Selected Projects

### Equipment

- Crystal Growth and Wafering Lab: Czochralski crystal puller; Inner diameter (ID) wafer saw; Ingot shaper, Wire-saw for silicon ingots; Walking Beam Furnace; Wafer polishing station; Wafer dicing machine.
- Thin-film Deposition Lab: Plasma-enhanced chemical vapor deposition (PECVD), Low-pressure chemical vapor deposition (LPCVD), Electron-beam and Thermal evaporation, Radio frequency (RF) and DC sputtering.
- Bulk Semiconductor and Thin-film Characterization Lab: Microwave Photoconductivity Decay Measurement ( $\mu$ -PCD); Laser Beam Induced Currents (LBIC); Hall Effect Measurement; Four point probe; Non-contact Resistivity Mapping; Deep Level Transient Spectroscopy (DLTS); Spectroscopic Ellipsometry; Wide-band Spectrophotometer; Extended range Infra-red Spectrometer with Hyperion Microscope.
- Nano-PV Lab: Specialized Glove-box and Wetbenches; Plasma and Thermal CVD tools for Nanowire Fabrication; Electron-beam Writing; Tools for Chemical Synthesis and Quantum-dot Embedded Layers; Centrifuge, titrator, shaker, high-speed shaker.
- Nano-materials Characterization Lab: Steady-state and Lifetime Fluorimeter Photoluminescence (PL) System with Quantum Yield, Cryostat and Fluorescence Microscope; Electron Back-scatter Diffractometry (EBSD); Cathodoluminescence (CL); Scanning Electron Microscope (SEM); Electron Beam Induced Current (EBIC).
- PV Device Fabrication Lab: High Temperature Four-stack Furnaces for Dopant Diffusion, Annealing, and Oxidation; Spin Casting Stations; Rapid Thermal Processor; Mask Aligner; Photolithography; Surface profilometer; Wet chemical Processing; Electro-chemical Etching Station; Reactive Ion Etcher; PECVD Thin-film Deposition; Anti-reflection Coatings.
- PV Device Characterization Lab: Quantum Efficiency Measurement; Integrated Sphere Reflection; Probe Station; Dark Current-Voltage (I-V) Parametric Analyzer; High Frequency and Quasi-static Capacitance-Voltage (C-V) Measurement; Solar Simulator.
- Screen-printing Metallization Lab: Semi-automatic Fine-line Screen-printer with full alignment capability; Drying Ovens; Infra-red Firing Furnaces.
- High Throughput Processing Lab: Conveyor Belt Furnaces; Large Area Processing.
- PV Module Fabrication Lab: Module laminator; Lay-up Table; EVA Optical Characterization.
- Design and Simulation Software: Computing facilities; Design Tools for High Efficiency PV Device Architectures; Simulation Software for PV System Performance and PV-hybrids.

### Supporting Partners

- UW
- Industrial funds
- CFI
- Ontario Innovation Trust
- NSERC (Strategic Grants, Discovery Grants, Strategic Networks)
- OCE
- ORF (Research Excellence)