Thermo Scientific K-Alpha

Other Equipment

KLA-Tencor P16+ Surface Profilometer

- 2-d line profiles
- 3-d mapping
- Low force option
- Extended (1 mm) range (z)
- Long scan (200 mm) length (x)
- 20 site sequencing (line/map) capability

Leica EM UC6/FC6 Cryo-Ultramicrotome

- Sectioning of biological and other samples at temperatures from -15° to -185°C
- Virtual connection to ToF-SIMS, XPS and preparation chambers via side port for vacuum/cryo "suitcase"

Leica EM TXP Target Sectioning System

- Stereo microscope to easily view target area
- Ease of use. Sawing, milling, grinding and polishing exactly to target - no need to remove sample

Vacuum/Cryo "Suitcase"

- Virtual connection of preparation chambers, ToF-SIMS, Thetaprobe XPS and cryo-ultra microtome

Preparation/Reaction Chambers

***Surface Interface* Ontario** was made possible through funding provided by: Canadian Foundation for Innovation, Ontario Research Fund, University of Toronto, McMaster University, Environment Canada, Celestica, VALE INCO, Novalis, Amtel and ITL..

Further support was received from several departments, both at Toronto and McMaster, via faculty participation.

***Surface Interface* Ontario** is a unique facility providing enabling information for a wide range of applications from many disciplines involved with advanced material research. Evolving from the Surface Science Unit of the Institute of Biomaterial and Biomedical Engineering (IBBME), it relocated into newly renovated laboratory and office space within the Department of Chemical Engineering & Applied Chemistry at the University of Toronto in Spring 2002. Further CFI funding (as part of their Leading Edge Fund) in 2006 has allowed for further expansion providing leading edge capabilities in several areas of surface analysis. ***SI*-Ontario** actively caters to both academic and industrial interests. Fostering collaboration between universities and industry, it allows for interactions which traverse the traditional boundaries between science, engineering and medicine.

Fee Structure

- Competitive rates and superior quality for research and development in both academic and industrial fields
- Three tier rate structure
  - ◊ Academic Rate
  - ◊ Collaborative University-Industry R&D
  - ◊ Contract

Further Information

For more information on the use of the facility, contact:

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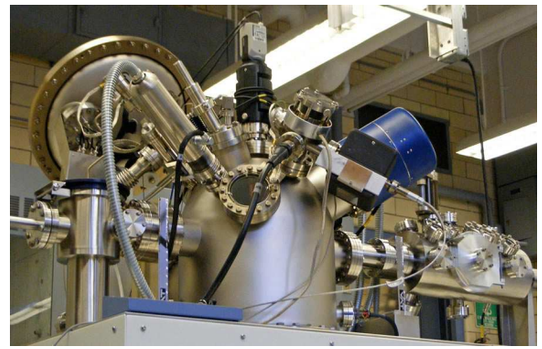


"Creating Partnerships for both Academic and Industrial Research"

Allowing researchers access to:

- Leading edge surface analytical equipment and the related expertise.

Providing:

- Enabling information and a means for collaborative research.

For:

- biomaterials
- semiconductors
- ceramics
- polymers
- forestry / pulp & paper
- catalysis
- environmental studies
- minerals
- metallurgy
- and more

The surface properties of a material greatly influence its interaction with its environment. Understanding these properties is of primary importance and modern methods of surface analysis allow us to do so.

Surface Interface* Ontario** (SI*-Ontario**) allows scientists and engineers ready access to modern surface analytical equipment, providing enabling information to the many disciplines involved in advanced materials research. Over the years, this core-resource facility has served both academia and industry, truly "creating partnerships for innovative research". The research supported by ***SI*-Ontario** is as diverse as its client base and is of high impact.

Techniques Employed

At the heart of the Facility are leading edge capabilities in two major complimentary surface analytical techniques, namely:

- X-ray Photoelectron Spectroscopy
- Time-of-Flight Secondary Ion Mass Spectrometry

These techniques are well established; however, recent advances in instrumentation have made these techniques even more powerful.

In addition ***SI*-Ontario** offers:

- Surface profilometry
- Cryo-ultramicrotome and other sample preparation techniques
- Versatile preparation/reaction chambers
- Vacuum/cryo "suitcase" for sample transfer
- Liaison with other nearby University facilities utilising related and complementary techniques

Thus, ***SI*-Ontario** provides a complete environment for many surface science studies as well as meeting the surface analytical needs of a majority of those involved in advanced material research.

Selected Equipment Features

- State-of-the-art ToF-SIMS with 3 ion gun columns
- 2 XPS systems - both small spot & high performance K-Alpha - for routine, automated analysis Thetaprobe - parallel ARXPS, imaging Auger, heating/cooling, capabilities
- Versatile preparation chambers attached to ToF-SIMS and Thetaprobe as well as stand-alone
- Easy attachment of custom-designed reactors and sample transfer devices
- Networked systems for off-line data analysis

X-Ray Photoelectron Spectroscopy

Principles

- Incident X-rays cause photoemission of electrons from the surface which are energy analysed
- Binding energies are characteristic of each element - can be used for identification
- Binding energy of a particular electron affected by the atom's environment - chemical information via the "chemical shift"

Information

- Elements Li and up, on both insulating and conducting samples
- Chemical bonding information via "chemical-shifts"
- 0.1 - 1 at% detection limit with straight-forward quantification (to ±5%)
- Surface specific (2 - 10 nm)
- Angle-resolved XPS allows for non-destructive depth information
- Ion sputtering allows for deeper depth profile
- High spectral resolution with monochromatic source
- Mapping capabilities with small analysis spot

Instrumentation

Thermo Scientific K-Alpha

- Fully automated, compact XPS
- Monochromated Al K_α X-ray source, variable spot - 30 - 400 µm
- Automated charge compensation
- Ar^+ ion gun for depth profiling, Zalar rotation possible
- 128 channel detector - allows rapid acquisition in snapshot mode
- Large area sample platen - large samples or numerous small ones
- Easy sample mounting and selection of analysis area
- Special wedges (20° and 30°) allow angle-resolved XPS to be performed
- All aspects of the operation of the K-Alpha are digitally controlled and capable of automation, including data work-up and report generation
- Allows for high volume, rapid throughput

Thermo Scientific Theta Probe

- High-end, small-spot XPS
- Monochromated Al K_α X-ray source, variable spot - 15 - 400 µm
- Dual anode (Mg/Ag) nonmonochromated X-ray source
- Effective charge compensation
- Ar^+ ion gun for depth profiling, Zalar rotation possible
- Parallel angle-resolved XPS (60° range)
- 2-d multi-channel detector
  - 110 channels for energy/snapshot mode
  - 96 channels for angle
- Large area sample platen - large samples or numerous small ones
- Easy sample mounting and selection of analysis area
- Field emission gun for Auger/SEM
  - 95 nm spatial resolution
- Heating/cooling – -150°C to +600°C
- Multi-port preparation chamber with heating / cooling sample parking and port for vacuum/cryo "suitcase"

Thermo Scientific Theta Probe

SIontario

Contact us to discuss your various experiments or needs

Time-of-Flight Secondary Ion Mass Spectrometry

Principles

- Pulsed primary ion beam
- Sputters ~ 0.1% of the top monolayer (static mode)
- Secondary ions (& neutrals) are emitted from surface
- Secondary ions mass analysed by measuring their time-of-flight from sample to detector
- Mass spectrum and secondary ion images used to obtain composition, distribution and molecular information of surface constituents

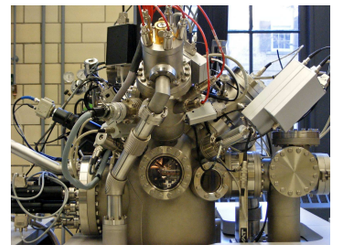
Why Time-of Flight?

- Parallel detection of all ions – great sensitivity. Low ion dose – static conditions ensures 1 – 2 monolayer analysis
- High mass range (up to 10k Daltons)
- Excellent mass resolution (> 9,000)
- Effective charge compensation for insulators, allowed by the pulsed mode of the source

Instrumentation

ION-TOF ToF-SIMS IV:

- Multiple Ion Sources
  - ◊ Liquid metal ion gun (Bi_n) - rapid submicron imaging, cluster source (to Bi_7) - enhances fragmentation and yield
  - ◊ C_{60} source - enhances fragmentation and yield, shallow & molecular depth profiling
  - ◊ High current Cs^+ ion gun - shallow depth profiling, optimal trace analysis of -ve ions
  - ◊ Electron impact (EI) gas ion source - O_2, Ar & SF_6
- Dual Beam Depth Profiling
  - ◊ Cs / EI / C_{60} for sputtering, Bi for spectral acquisition
- Variable Temperature
  - ◊ Temperature stage (-150°C to +600°C)
  - ◊ Analyse volatiles
- Other Features
  - ◊ Effective charge compensation
  - ◊ O_2 gas flood to increase +ve ion yield
  - ◊ Computer control – for analysis, + off-line for work-up, data base
  - ◊ Preparation / sample treatment chamber

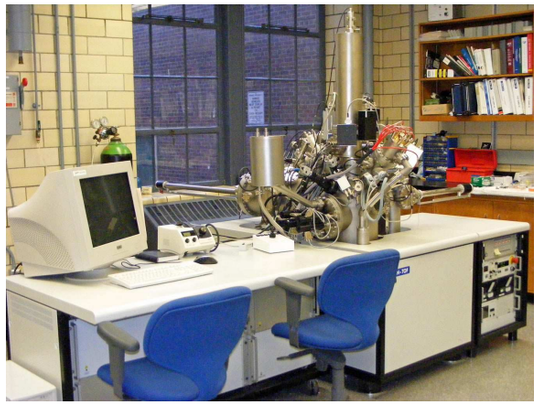


Composition and distribution of species at the surface

- Elemental & chemical analysis
- Submicron imaging (Bi_n gun) 60 nm (e^-), 100 nm (ions)
- PPM sensitivity
- Ultra-shallow depth profiling - particularly with C_{60}
- High molecular ion yields - again with C_{60} & Bi cluster
- *In situ* variable temperature studies

Custom Preparation Chamber

- Versatile configuration for custom set-up
- Port for vacuum/cryo transfer "suitcase"
- Ports for other transfer modules/auxillary reaction chambers (vertical or horizontal samples, compatibility with a variety of mount designs)
- Internal bake-out - rapid UHV recovery
- Heating/cooling of sample (-150°C to +600°C)



ION-TOF ToF-SIMS IV
- the first 3-column ToF-SIMS IV