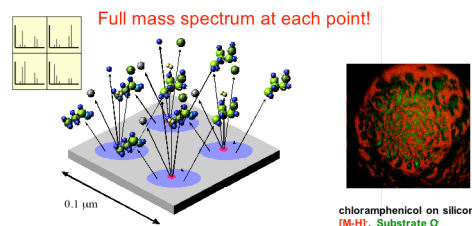
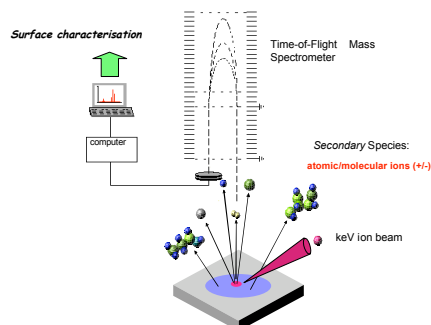


# New Developments in ToF-SIMS Surface Mass Spectrometry with ATR-IR Spectroscopy

*ToF-SIMS has developed into powerful technique for mass spectral analysis of chemically complex surfaces, dramatically enhanced recently by the use of polyatomic primary ions -  $Au_n^+$ ,  $Bi_n^+$  and particularly by  $C_{60}^+$  beams developed at Manchester*



*A four year coordinated multi-centre project started in September 2005 to research the fundamentals, to enhance the ToF-SIMS technology and to integrate ATR-IR into the instrumentation and thereby to enable combined MS and IR analysis*

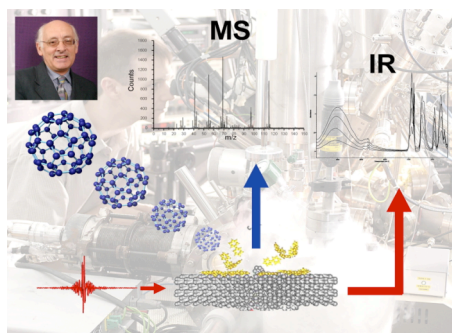
## Partners

**The University of Manchester:** Centre for Instrumentation and Analytical Science, School of Chemical Engineering and Analytical Science: Principal Investigator: Prof John C Vickerman. Co-Investigators: Dr Nick Lockyer, Dr. Peter Gardner, School of Chemistry: Dr Andrew Horn, Prof. Roy Goodacre

**The University of Surrey,** Centre for Solid State Electronics: CoPI: Prof Roger Webb, CI: Dr Karen Kirkby

**Industrial Collaborator - Ionoptika Ltd,** Southampton Paul Blenkinsopp, Rowland Hill and Andy Barber.

**International Collaborators: Pennsylvania State University:** Profs Nick Winograd and Barbara Garrison



## TWO RESEARCH THEMES

1. To understand the mechanisms of polyatomic ion sputtering and hence optimise the ion beam technology and analytical protocols for analytical mass spectrometry, molecular depth profiling and imaging.
2. To design, build test and characterise a new combined ToF-SIMS-ATR-IR instrument for biological and materials research.
  - b). To develop and prove an MS/MS facility for ToF-SIMS
  - c). To develop second generation fullerene ion beam systems with high spatial resolution

## THEME 1 - Fundamentals

**$C_{60}$  and similar cluster ion beams show the potential to revolutionise ToF-SIMS**

- Dramatic increases in ion yields from organic and bio materials enabling chemical imaging with sub-1  $\mu\text{m}$  resolution.
- Dramatic reduction in bombardment induced chemical damage enabling the *static limit* to be abandoned and molecular depth profiling to be implemented.

HOW & WHY?

### • AT MANCHESTER AND PENN STATE

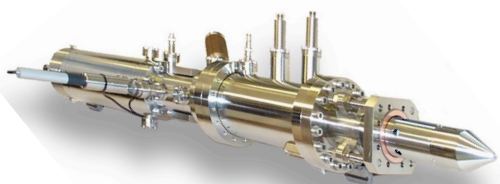
- Experimental studies of sputtering of bio-systems using  $C_{60}$  and metal cluster ions.
- **Emrys Jones (RA) and Jeanette Sørensen (Student) at Manchester and Prof Winograd's students at Penn State.**

### • AT SURREY AND PENN STATE

- Molecular dynamics simulations of polyatomic ion sputtering.
- **RA at Surrey and Prof Garrison's students at Penn State**

## THEME 2 - Instrumental developments

**The new polyatomic ion beams provide great increases in mass spectral sensitivity. The benefits can only be realised with new instrumentation.**



### • AT MANCHESTER WITH IONOPTIKA LTD

1. High stability ToF-SIMS instrument to deliver sub-1  $\mu\text{m}$  spatial resolution chemical imaging of bio-systems.
2. Enhanced mass spectrometry with the implementation of tandem MS-MS capability.
3. Enable combined IR-MS analysis by integration of ATR-IR into the ToF-SIMS instrument.
4. Development of enhanced  $C_{60}$  beam system.
5. Testing instruments with cancer cell and environmental particulate studies

- **Dr John Fletcher (RA) and a student at Manchester with Paul Blenkinsopp, Andy Barber and Rowland Hill at Ionoptika**

*Progress will be reviewed annually at a Symposium by an Advisory Panel: Professors David Castner (University of Washington, Seattle), Graham Leggett (Sheffield); Mike Chesters (Nottingham); Drs Arnaud Delcorte (Louvain) and Ian Gilmore (NPL).*