



BIOHAZARD

Micro Sensor Systems for Bio and Chemical Detection

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www.csiro.au

Micro Analysis Systems

Outline

- Background to the team and what we do
- Components of a sensor system
- Detection technologies
- Micro-fluidics – lab-on-a-chip
- Our skills and technology – what we can do

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Micro Analysis Systems

Background


- Team formed in 2005 in response to Australian government request for research into counter measures for chemical and biological terrorism
- The aim is to combine physical and chemical methods with micro fabrication techniques to develop hand-held low-cost systems for chemical and biological analysis.
- The main focus is in the development of technologies for detecting molecules and biologically-related molecules in particular.

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Micro Analysis Systems Team

Team profile

- Physicist, surface scientist, microbiologist, electronics engineers, immunologist, biotechnologist and experts in fluid dynamics, micro fabrication and mathematical modelling.

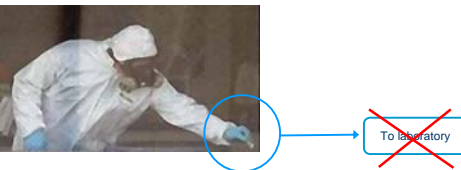


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On-site analysis system

- Must be portable and easy to carry
- Needs high selectivity to distinguish "good" from "bad"
- Aim to detect chemicals in liquids

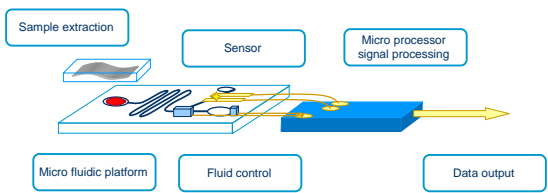


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A typical sensor system

- Micro fluidic device for pre-processing the sample
- A sensor device that detects the chemicals of interest
- A system for controlling the micro fluidic device and reading out the sensor



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CSIRO **Detecting biological molecules**

Antibody – antigen reactions

- Use nature's defence mechanism to detect specific molecules (antigens)
- The antibody is tailored to recognise "key" shapes on the antigen
 - Lock and key mechanism

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CSIRO **Bio sensors**

Antibody – antigen reactions for sensors

- Develop antibody reagents that bind only with the molecule of interest
- CSIRO Molecular and Health Technologies, Livestock industries
- Selective binding on a surface

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CSIRO **Detector technologies**

Potential detector technologies

- Electrochemical and electrochemical luminescence
- Quartz crystal microbalance
- Surface enhanced Raman spectroscopy
- Surface plasmon resonance
- Evanescence wave sensors
- Fluorescence
- Micro spectrometers
-

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CSIRO **SPR biosensor**

Surface plasmon resonance sensor

- Common method for studying binding reactions in biology
- Optical method based on the absorption of light in a gold film
- Absorption very sensitive to molecules on top of the gold film

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CSIRO **SPR biosensor**

Bio-sensor prototype

- Hand-held battery powered unit, menu driven control
- Internal read-out or can be connected to a laptop for data display
- Sensitivity – detection of mass binding to about 20 picograms
- Demonstrated detection of avian influenza

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CSIRO **Micro fluid systems**

What is micro-fluidics?

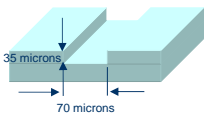

- Study of fluid flows in very small channels (widths below 1 mm)
- Applications in fluid processing – lab-on-a-chip
- Require methods for filtering samples, mixing reagents, pumping fluids, ...

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Micro fluid systems

Chemical Separation

- Micro fluidic channels embossed in plastic
- Capillary electrophoresis

PMMA polymer chip



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Micro fluid systems

Manufacture

- Low-cost photolithography process based on printed circuit board photo-patterning methods
- Electroplating for master plates
- Hot embossing for replication

DISPOSABLE!

Micro channels in photoresist

Nickel replica

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Analysis Systems Applications

Applications of hand-held systems

- Bio-warfare agents : anthrax, ricin, ... (CSIRO internal project with DSTO)
- Chemical precursors for explosives or toxic gas breakdown products – NSST funded with ACS and AFP
- Initial screening for forensic applications
- Monitoring disease outbreaks for livestock industries
- Plant biosecurity
- Point-of-care medical monitoring

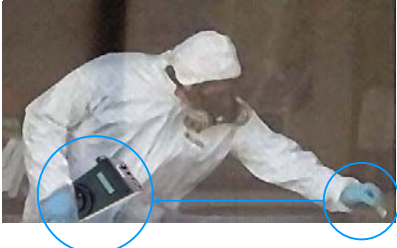
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Where to from here?

- We have basic components for a large variety of sensor systems
- We have methods for mass production of key components (e.g. micro fluidics)
- Need to integrate micro-fluidics with detection systems
- Looking for collaborations with end-user groups to help guide the technology development
- Looking for collaborations with manufacturers to develop commercial systems

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“Lab-to-sample” analysis system



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Thank You

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