New Technologies, New Opportunities for Odour Detection

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Types of Gases
Sulphur compounds are the biggest problem

Organic

- sulphur compounds: H_2S, mercaptans/thiols
- amines
- aldehydes, ketones, alcohols
- methane

Inorganic

- NO_x, SO_x (acid gases)
- Ozone, chlorine/ bromine (disinfectants)
- Ammonia (nitrogenation)
- Hydrogen (used as surrogate for clean landfills)

Current Technologies
OK, but could do better

Organic

- Mass Spectrometry (MS) or GC/MS
- Long pathlength FTIR
- Photoionisation Detectors (PID)
- Electronic noses (sensor arrays)

Inorganic

- Electrochemical cells
- NIR laser spectrometry

New Technologies
Not there, yet

Organic

- NIR solid state spectrometry
- Nanomaterial sensor arrays (next generation electronic noses)
- Micro GC/MS (low cost, limited life detectors)
- Ion Mobility Spectroscopy (IMS/ FAIMS)

Inorganics

- Quantum Cascade Laser (QCL) spectroscopy
- Cavity Ring Down Spectroscopy (CRDS)
- Long wavelength NDIR
- Improved sensitivity electrochemicals

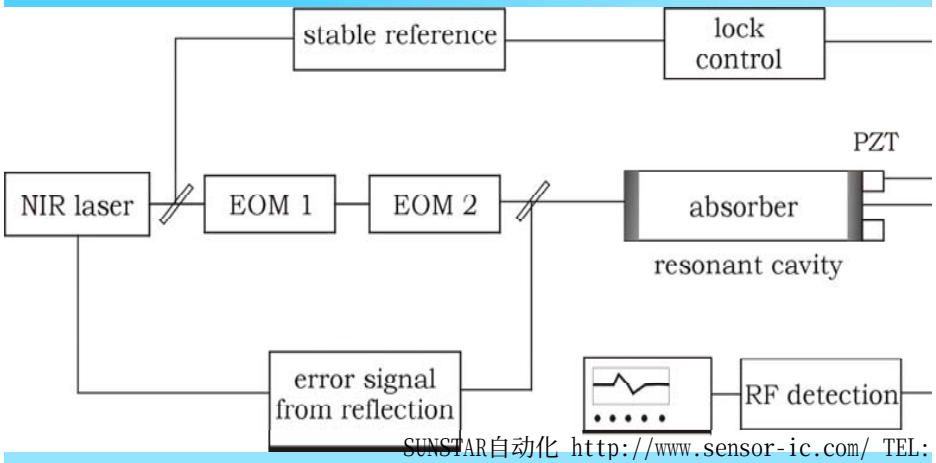
Quantum Cascade Lasers

- Solid state infrared lasers are now available at wavelengths to 20um

Resonant Cavity Laser Systems

- Bounce the light through the test cell hundreds, thousands of times to improve resolution
- Cavity Ring Down Spectroscopy (CRDS) is now commercially available for some gases

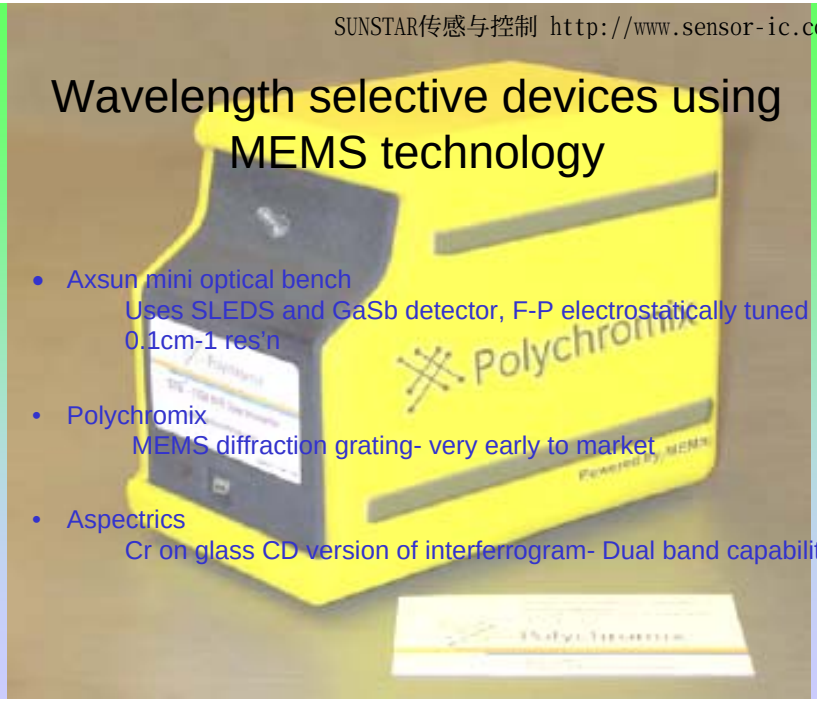
Resonant Cavity Diode Laser Absorption



Near- Infrared spectroscopy has just become cheaper, better

- MEMS devices are replacing expensive optical wavelength selection systems

Wavelength selective devices using MEMS technology



- Axsun mini optical bench
  Uses SLEDS and GaSb detector, F-P electrostatically tuned
  0.1cm-1 res'n
- Polychromix
  MEMS diffraction grating- very early to market
- Aspectrics
  Cr on glass CD version of interferrogram- Dual band capability

Electronic noses
Sensor arrays

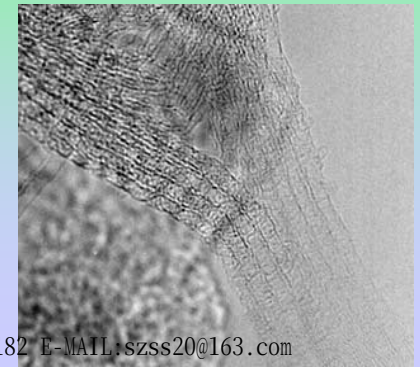
- Based on polymer or semiconductor sensors
- Analysis of the measurements is difficult- keeps the programmers busy.
- Humidity, sensor drift, and array "training" are continuing problems. Hopefully, new sensor materials will rescue this technology.

Nanomaterials improve sensor performance

- Carbon nanotubes are in development as sensors for ammonia and hydrogen.
- Better organometallic sensing layers are more repeatable, thanks to organic LED (OLED) work for new TV, PC displays.

Carbon nanotubes

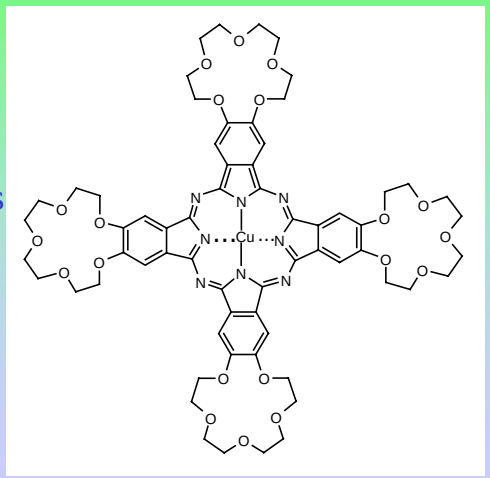
- Chemical resistors, or-
- Electrochemical replacements for graphite



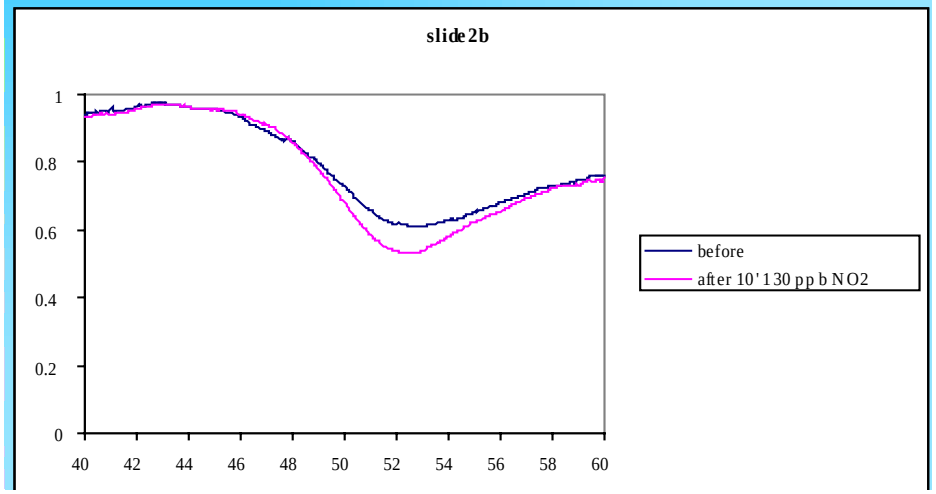
Single Wall CNT

Sensing layers: organometallic chemistry at its best

- Phthalocyanines
- Crown Ethers
- Dendrimers
- Hydro-, lipophyllic chains
- Chiral compounds
- Thiol on gold SAMs



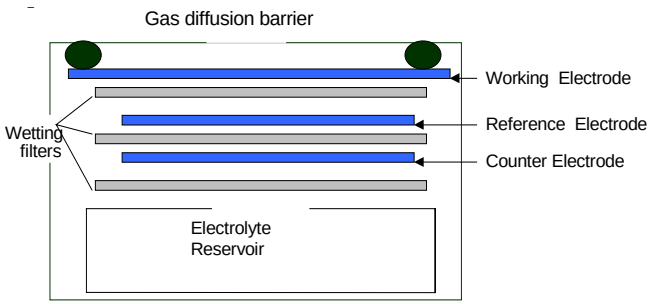
SPR Response to 130 ppb NO_2



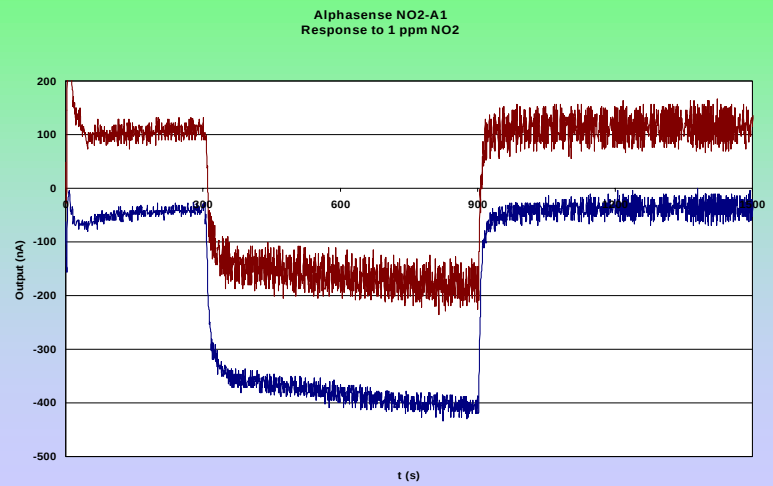
Amperometric Sensors

- Standard gas detection technology for H_2S, SO_x and NO_x continues to improve itself.

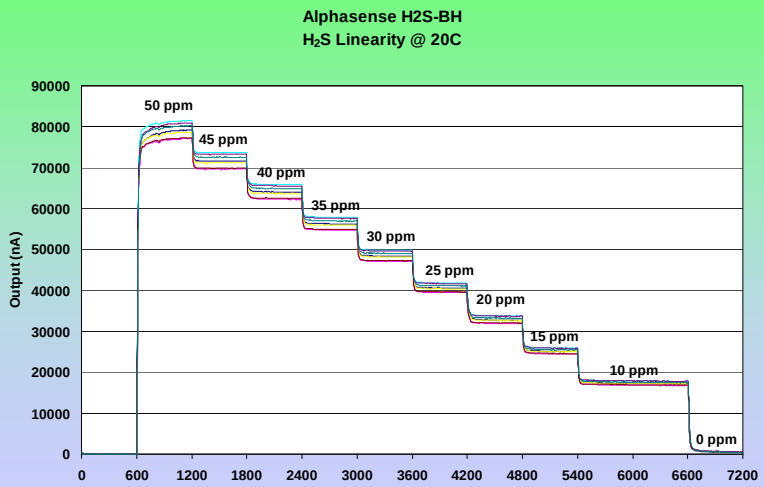
4 Amperometric Electrochemical



Electrochemical response to 1ppm NO_2



Electrochemicals give good response



Gas Cameras

- The ultimate tool to measure odour dispersion in real time.
- But- a technical challenge still under development

Electronics and Computing come to the rescue

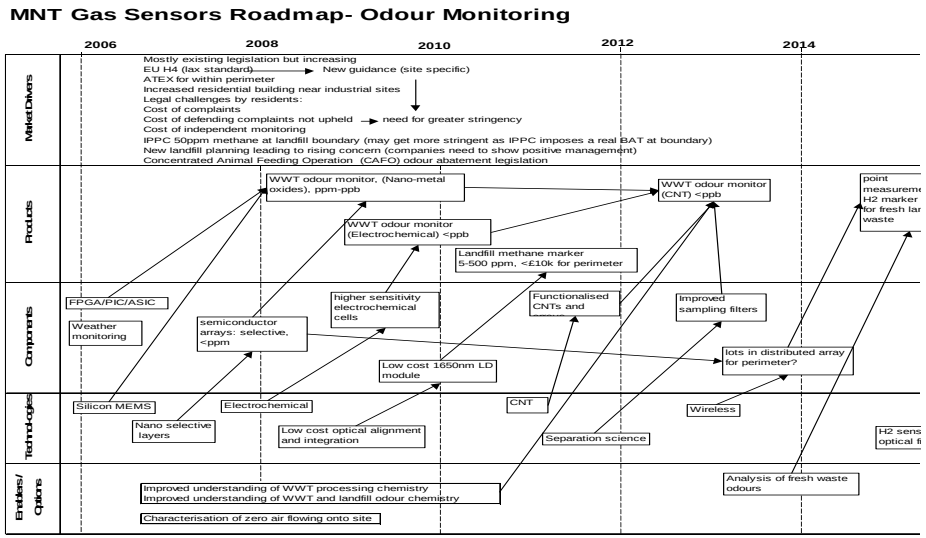
- ASICs and FPGAs give computing power at the sensor.
- Low power wireless ZigBee (IEEE 802.15.4) WiFi and GPS allow instant network systems without cables.
- Silicon MEMS permit low cost sensor arrays.

Conclusions

- VOC analysis using **spectroscopy** will become cheaper.
- H_2S and other inorganic gases will be cheaply measured at the 10-50ppb level with better **electrochemical sensors**.
- New **sensor materials**- they may be the hope for ammonia and mercaptans, but- still too early.
- Dioxins, PCBs will be analysed at the sub-ppb level inexpensively with the next step after PIDs: **Differential Mobility Spectrscopy**.
- **Research** is needed to determine how the hydrocarbons and hydrogen are useful surrogates for landfill monitoring.

What does the future offer us? When?

- These technologies are in development.
- But we are not there yet- products must be developed and supporting research is needed to ensure correct interpretation.



MNT Gas Sensor Forum

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