

Microsensors for Clinical Diagnostics

*The IEE Medical Electronics - Hi-Technology at the Cutting Edge
Dec04*

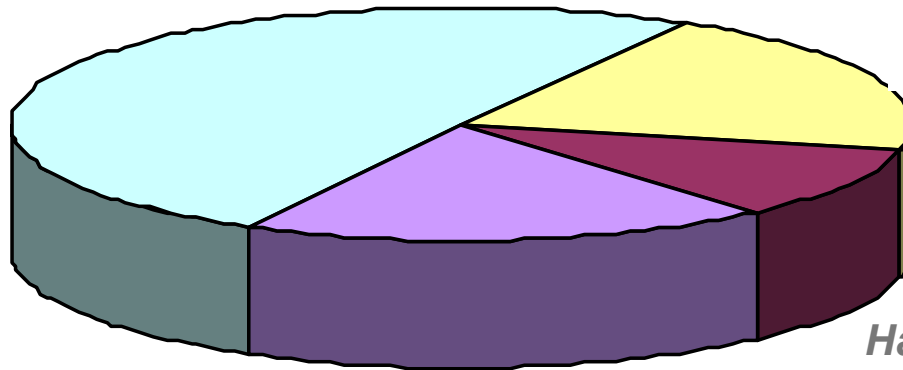
Stuart Hendry CEO

The Market

Worldwide Diagnostic Product Sales 2002
\$23 billion

Various
\$11.6bn

Immunoassay
\$4.6bn



Clinical chemistry
\$4.4bn

Haematology
\$2.3bn

*Centralised
labs.*



*Point of
Care*

One example: blood gas analysis



Picture courtesy of 



- *Central laboratory or ward based instrument*
- *Low cost per test*
- *Long turn-around time*
- *Blood contact*

- *Hand-held*
- *One-shot test*
- *Higher cost per test*
- *Shorter measurement time*
- *Blood contact*

- *Close to patient*
- *Automation potential*
- *Short measurement time*
- *Wide menu*
- *Low cost*
- *Limited blood contact*
- *Potential for closed-loop ventilator control*

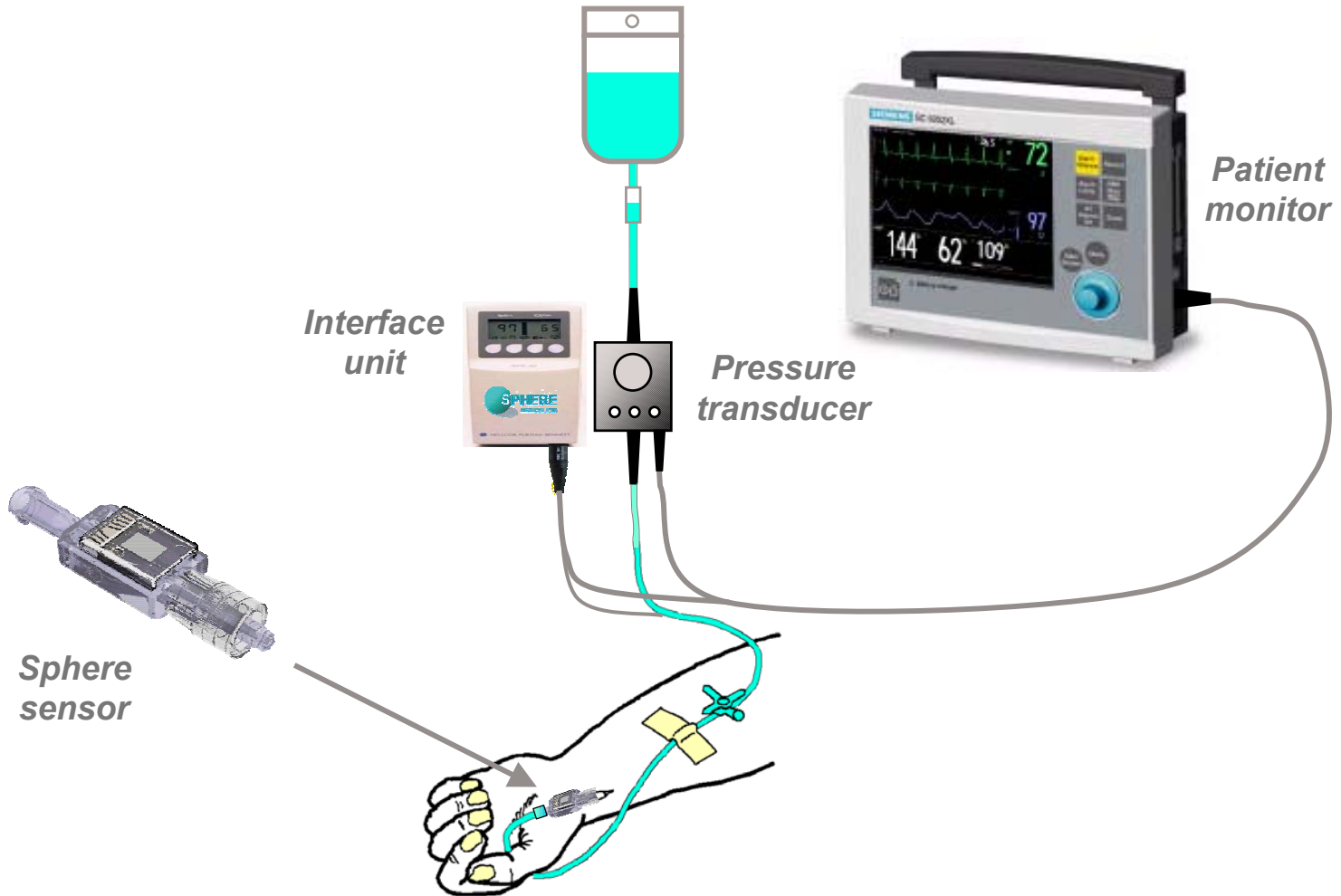
70's

80's

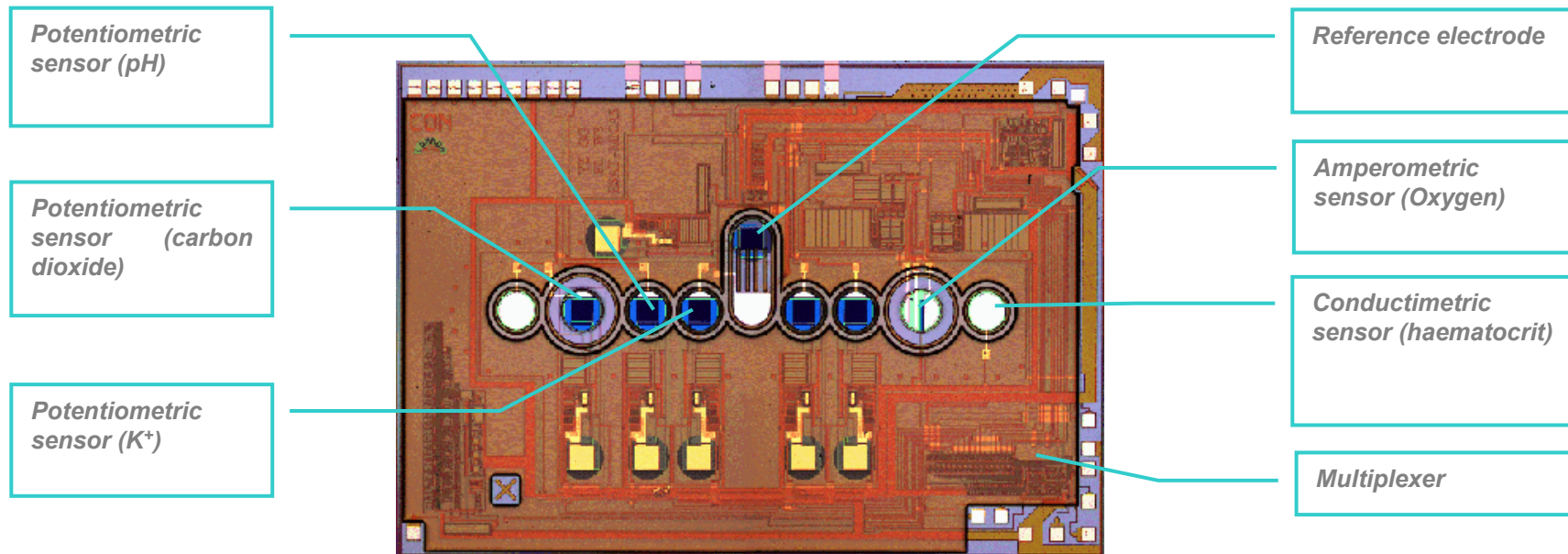
90's

00's

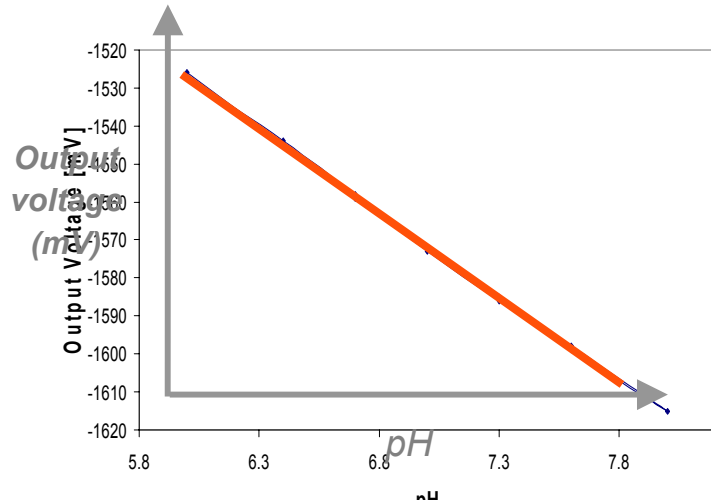
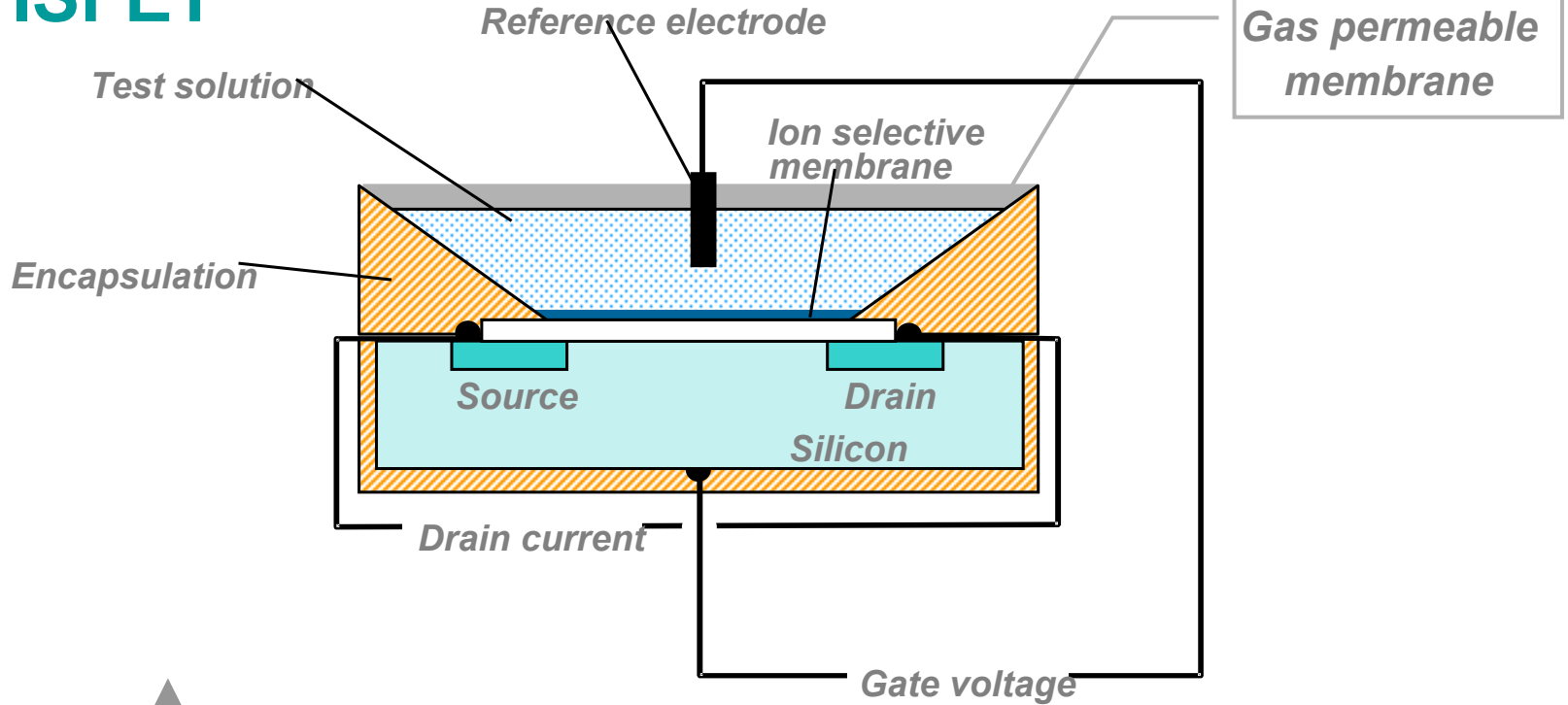
Sphere's Proxima system



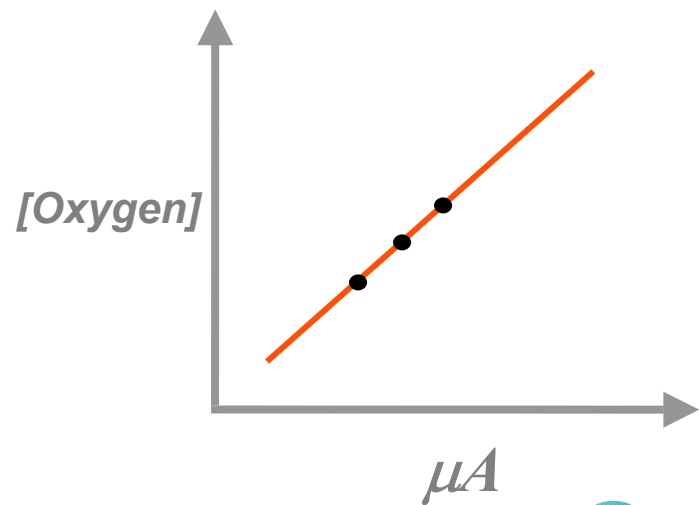
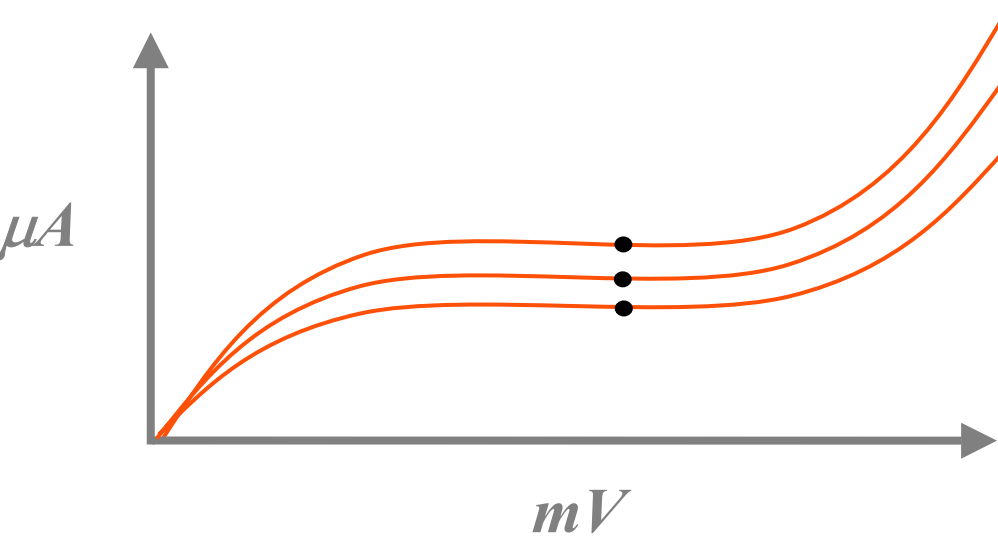
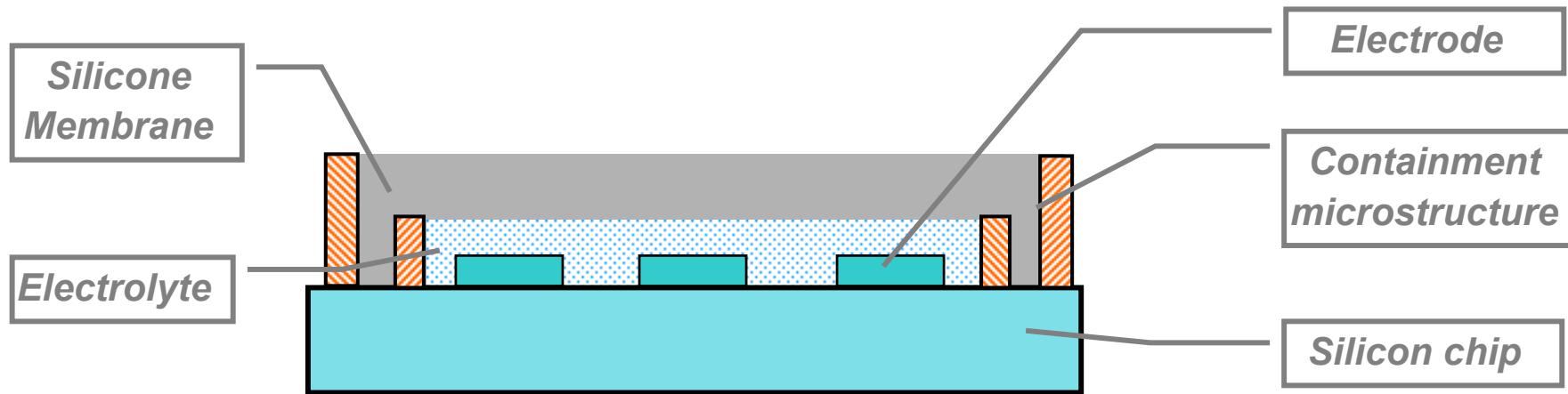
Sphere's microanalyser chip



ISFET



Amperometric oxygen microsensor



MIP design - Cranfield Centre for Supramolecular Technology

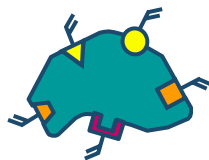
Template



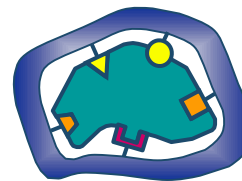
Complex



formation



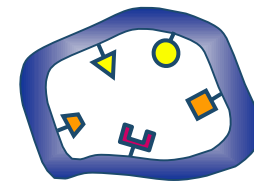
Polymerisation



Extraction



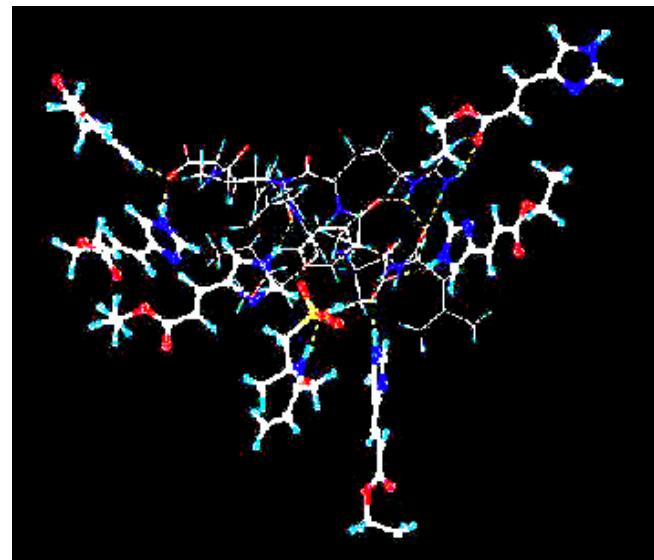
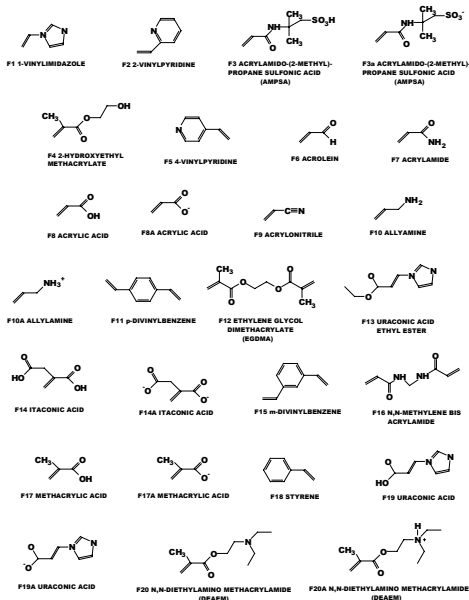
of template



Monomers



Database of Monomers

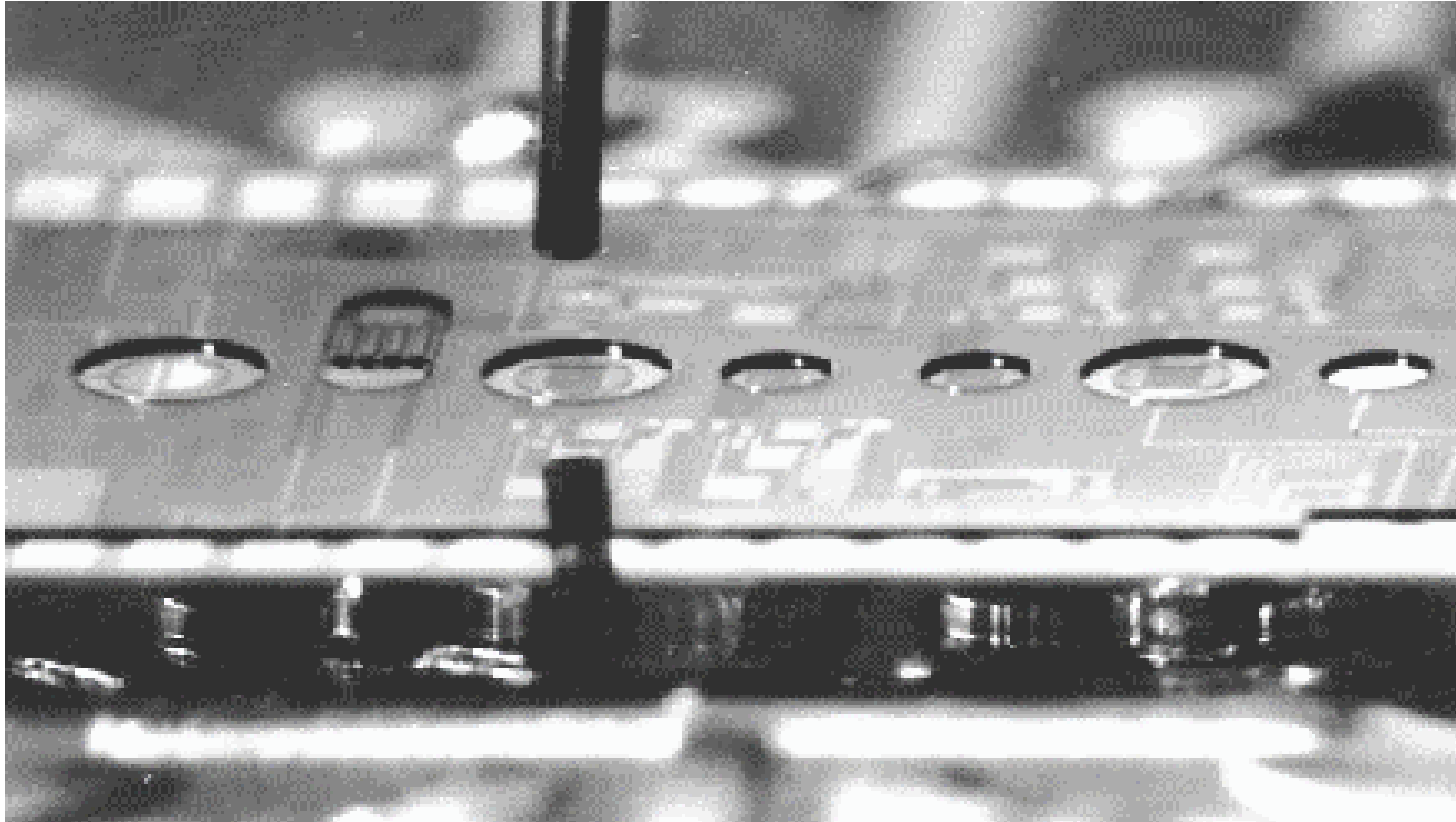


MIP-based sensors for clinically relevant analytes

Template	Detection principle
Amino acids and derivatives	Electrochemical, QCM, Optical
Aniline and phenol derivatives	Electrochemical, Optical
Anions and cations	Electrochemical, Optical
Barbituric acid	Electrochemical
Caffeine	QCM, optical
Chloramphenicol	Optical
Cholesterol	Electrochemical
Cinchona alkaloids	Optical
Clenbuterol	Electrochemical
Epinephrine	Optical
β -Estradiol	Optical

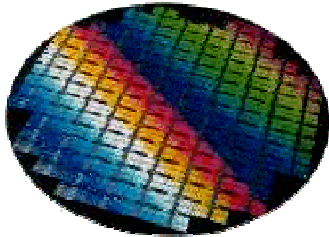
Template	Detection principle
Flavinol	Optical
Gases	Electrochemical
Morphine	Electrochemical
Nicotine	QCM
Nucleic acids and derivatives	Electrochemical; Optical
Paracetamol	QCM
Phenactin	QCM
Propofol	Optical
Propranolol	Optical
Sugars and derivatives	Electrochemical; Optical
Terpene	QCM
Vitamin- K1	QCM

Membrane Dispensing Process



Manufacturing process

modified
CMOS process



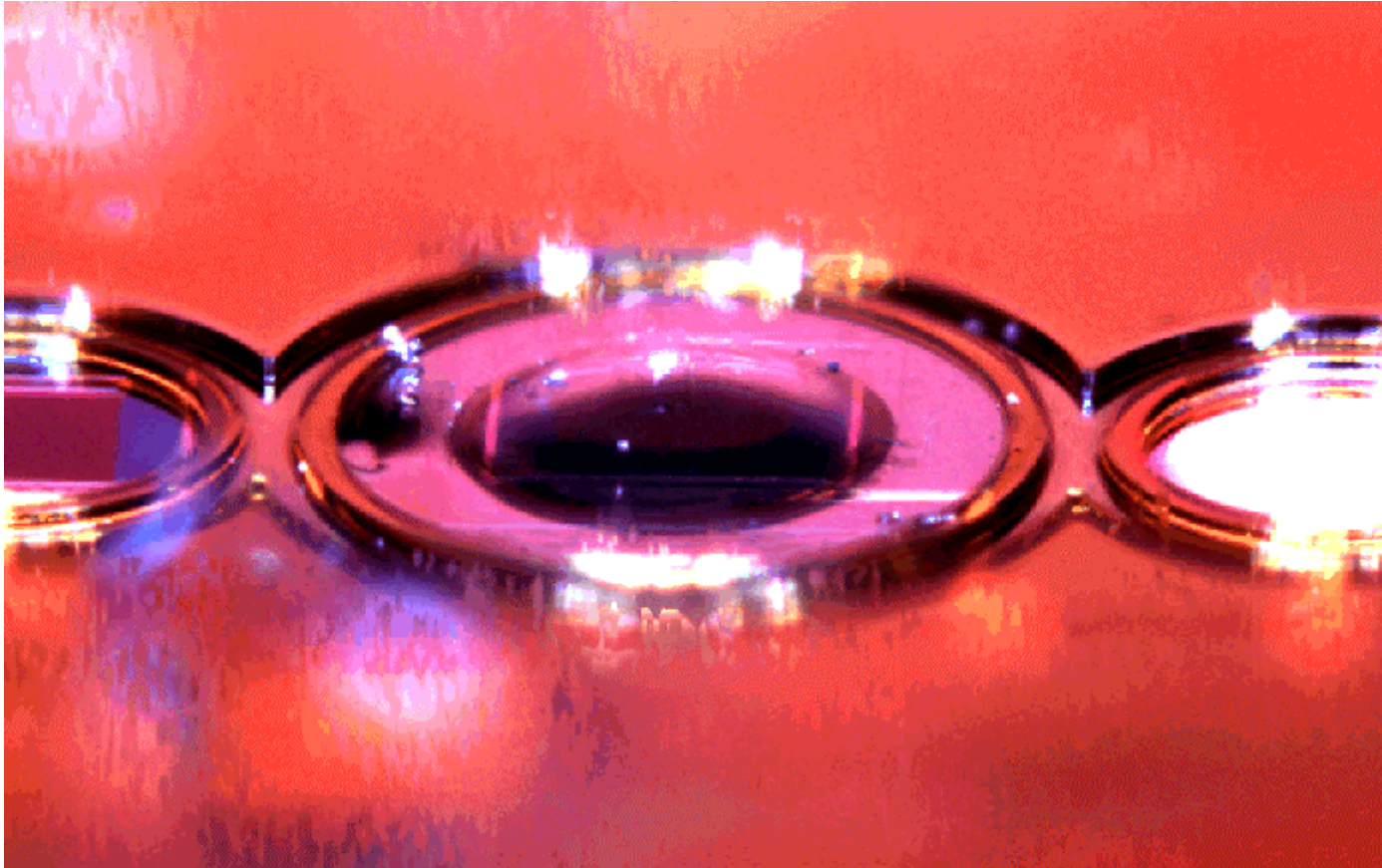
functionalisation

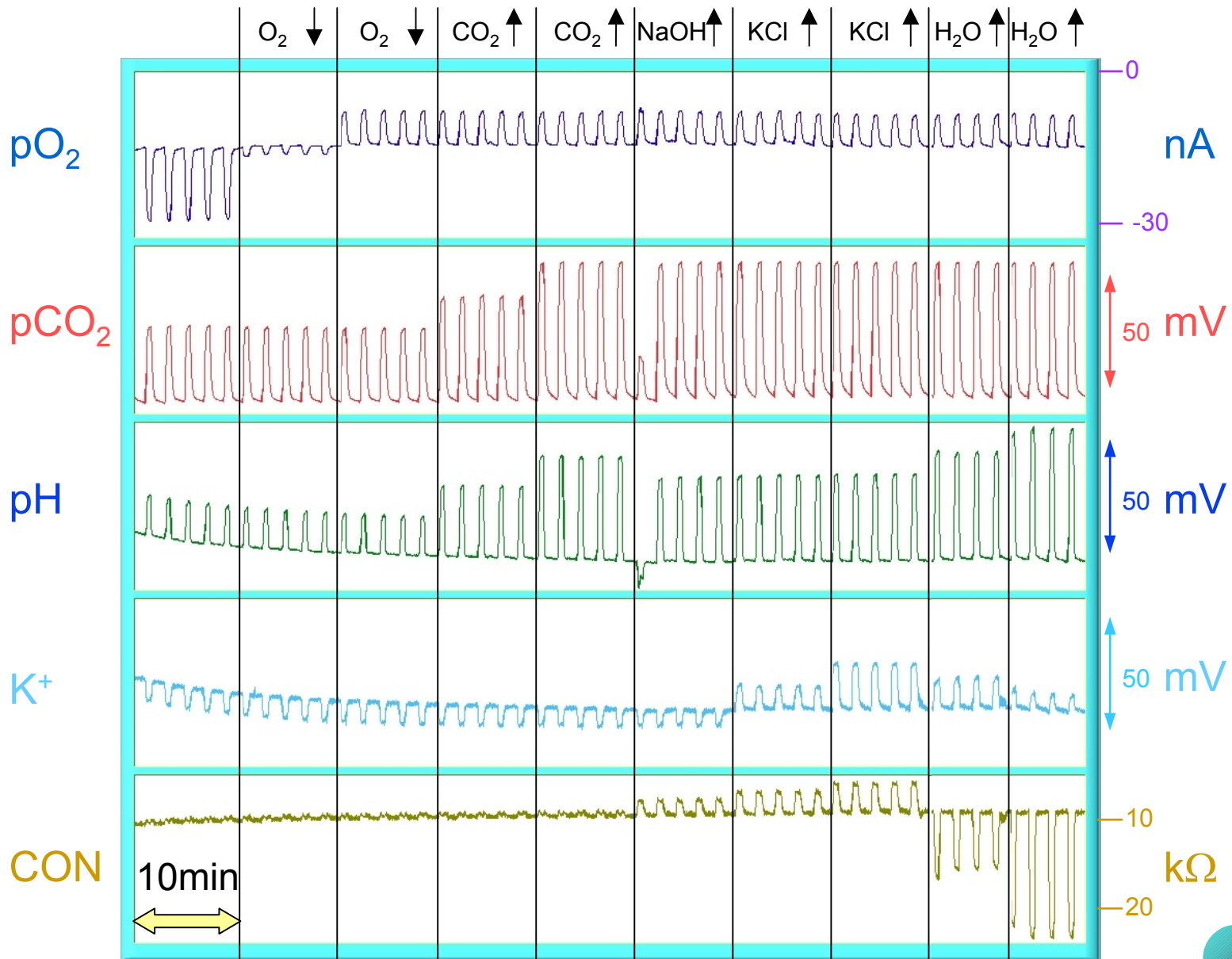


packaging

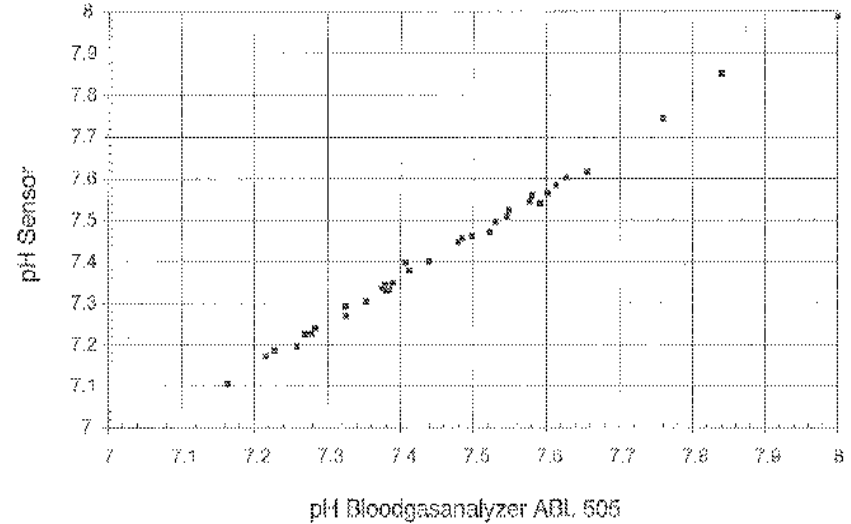
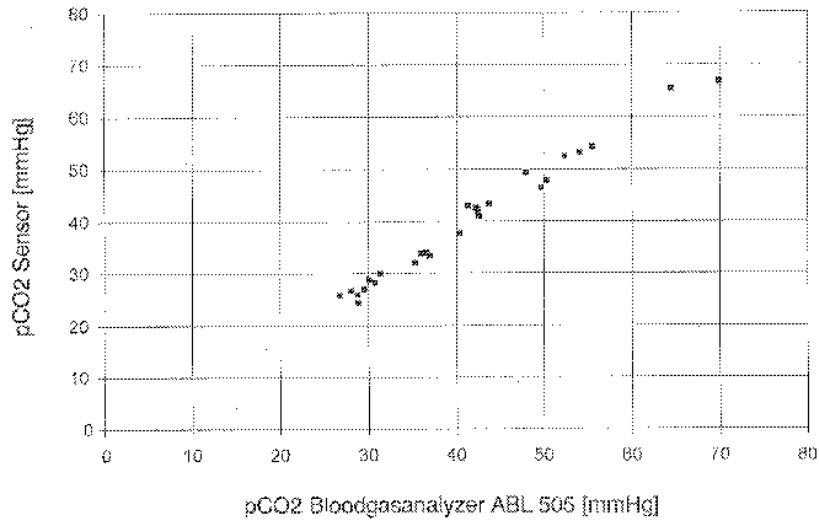
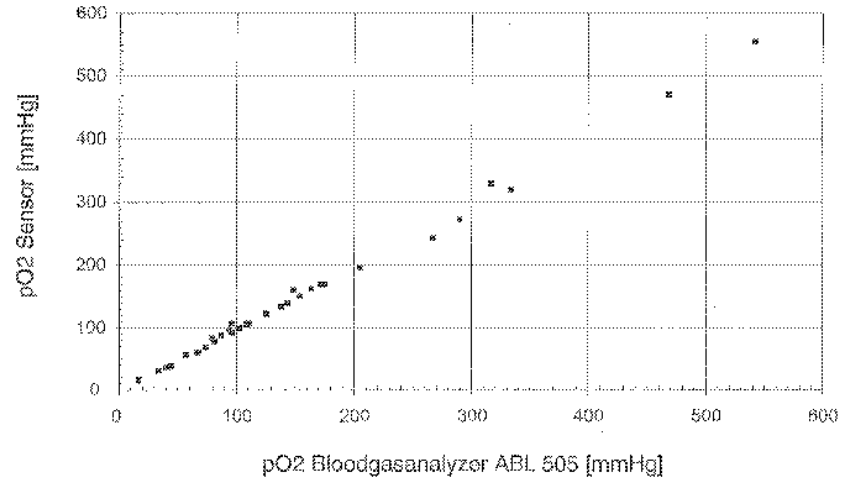


Structure of Hydrated pCO₂-Sensor

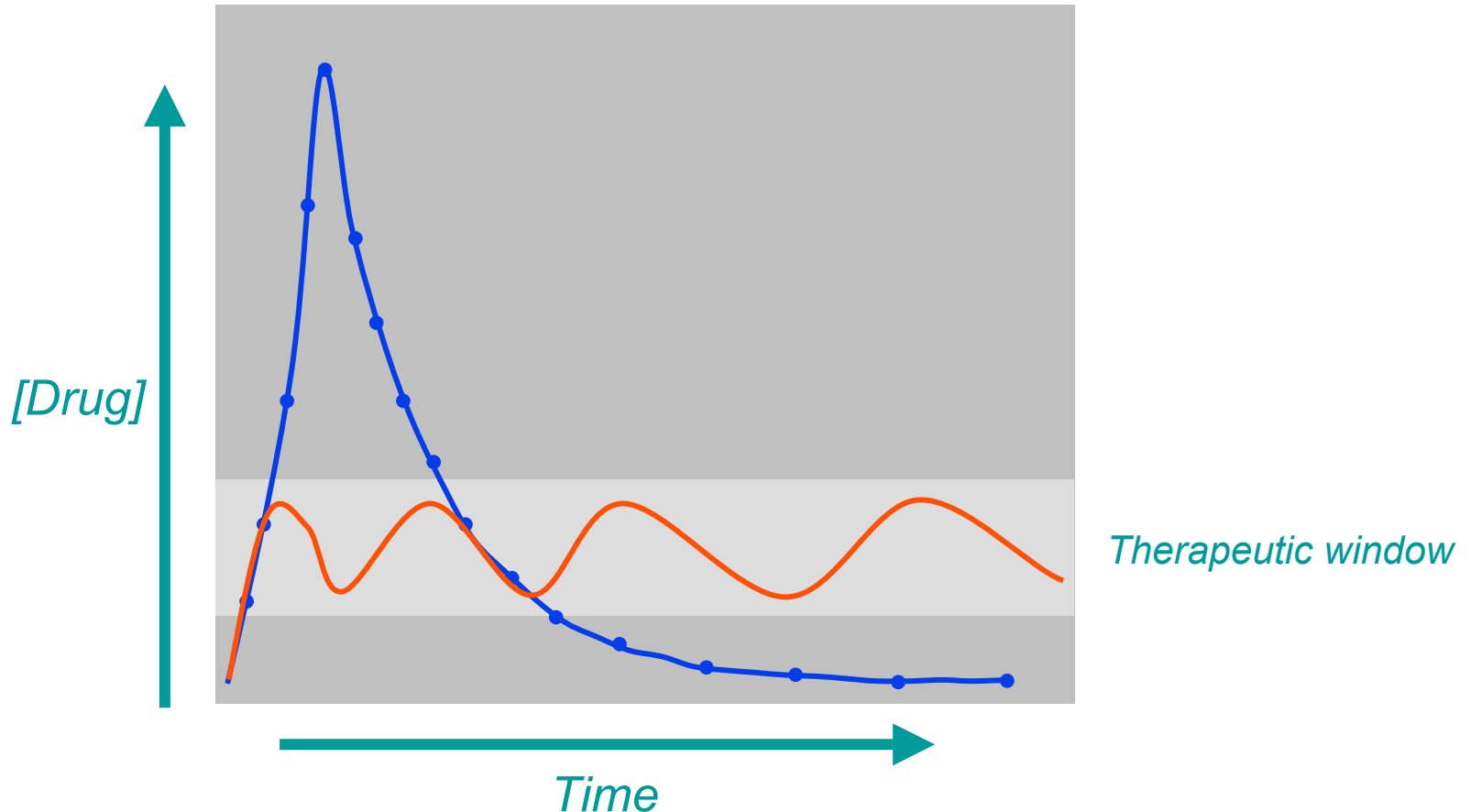




In-vivo Testing



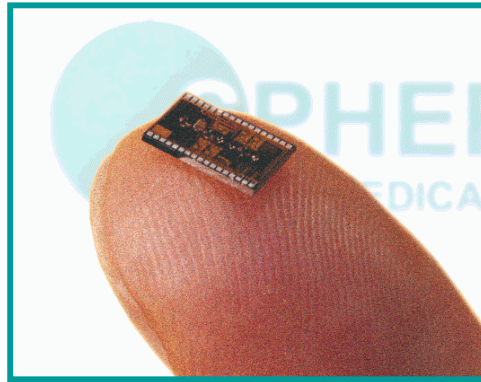
Benefit of real-time measurement



Van den Berghe G, Wouters P, Weekers F, *et al.* Intensive insulin therapy in critically ill patients. *N Engl J Med.* 2001; 345:1359-1367.

Advantages of Sphere Microsensor technology

- *Cost*
- *Reproducibility, manufacturability, reliability*
- *Large and expandable menu*
- *Size and response time*
- *Ability to generate new sensing and treatment modalities*
- *Potential for titration of therapy and closed-loop control*



Thank you