sims

SEVENTH FRAMEWORK PROGRAMME

Period 1 Summary

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Alere

University of Liverpool

VTT

DCU

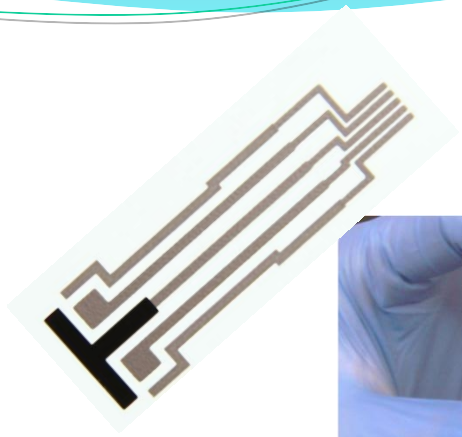
Fraunhofer ENAS

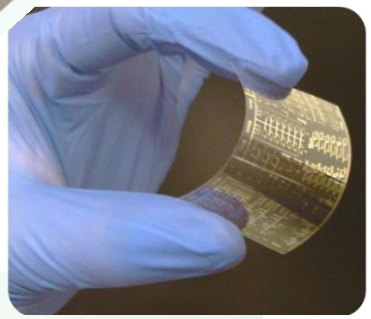
Introduction

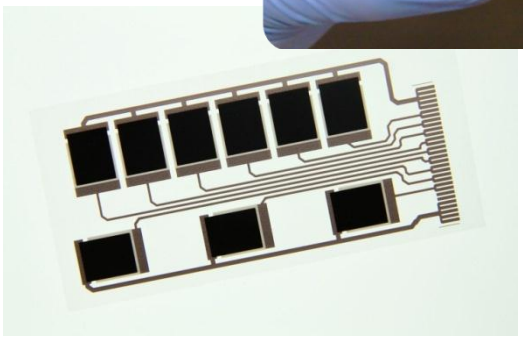
- SIMS is the development of a Smart Integrated Miniaturised Sensor System
- It uses a combination of organic and printed electronics to deliver a revolutionary diagnostic device technology
- It combines organic electronic circuits, printed biosensors, printed displays and printed batteries onto a single substrate
- The device will have true sample to result functionality and will be suitable for the measurement of analytes such as glucose and cholesterol

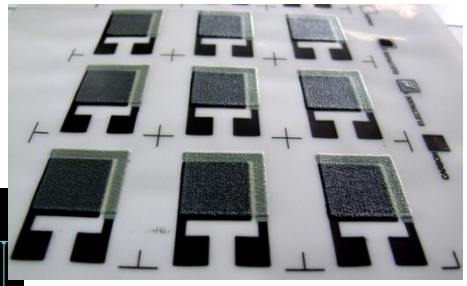
Research programme

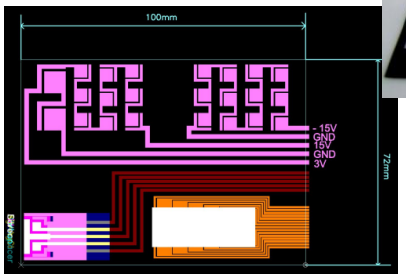
- The research involves developments in several areas
  - The printed cholesterol biosensor
  - The organic circuit able to convert the sensor signal to an output on the display
  - The printed display
  - The printed battery
  - The integration of all these components onto a single substrate











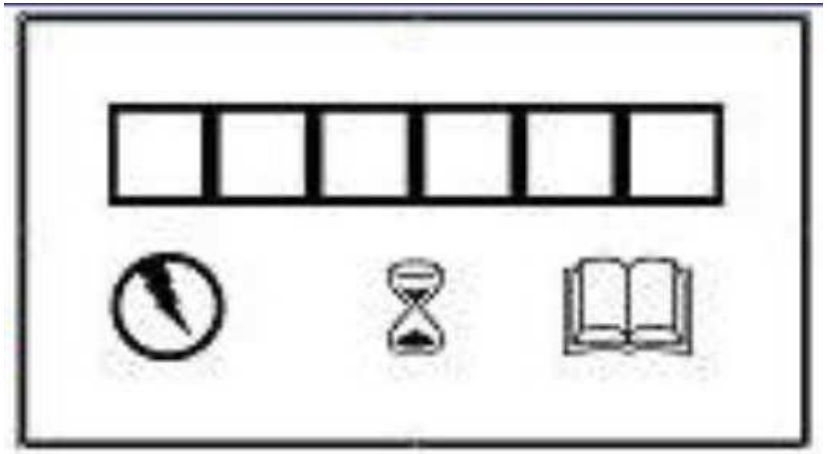
Progress during period 1

- Progress to date has involved preliminary work of
  - Defining the characteristics of the device
  - Developing the subcomponents
  - Paving the way for their integration

- The following slides highlight key developments in these areas

Definition of the SIMS device

- Our diagnostic company partner, Alere, carried out market research to determine
  - Where the technology might find most widespread application
  - How it should operate
- SIMS has widespread application potential in a range of point of care and self-test scenarios
- The device should be a simple, semi-quantitative device to indicate elevated cholesterol levels that would require further attention
- This would be achieved using simple visual icons and an indicator display bar

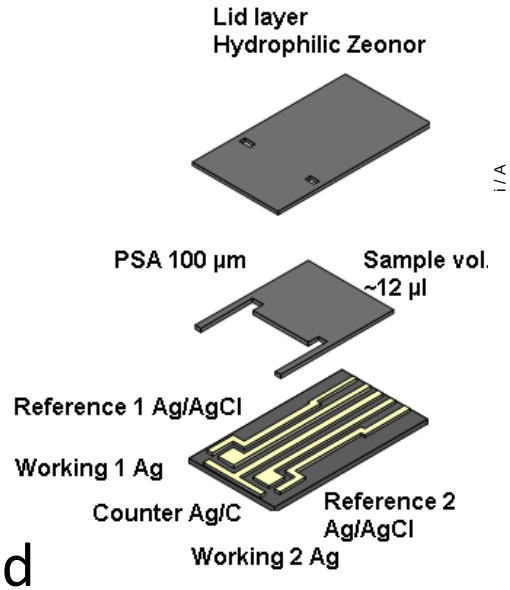


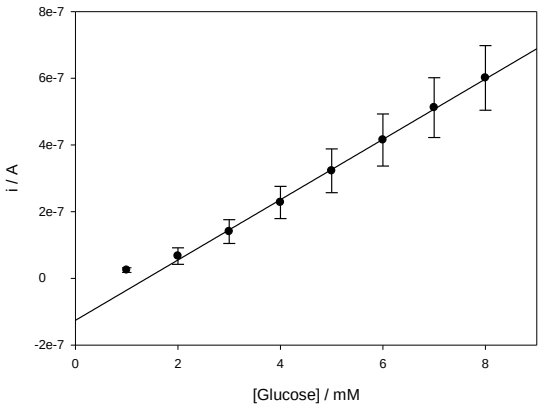
The SIMS display

A six bar display will light up sequentially depending on the analyte concentration. Simple power on, timing and error icons will assist the user

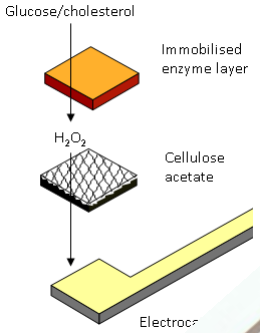
The biosensor

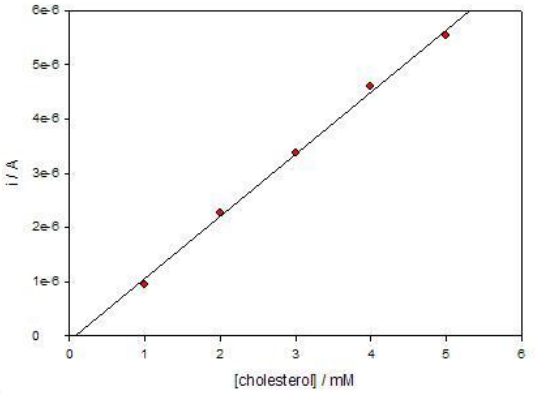
- A printed biosensor has been developed
- Combine screen and inkjet printing
- Based on nanostructured electrocatalyst
- Measures hydrogen peroxide
- Can measure both glucose and cholesterol



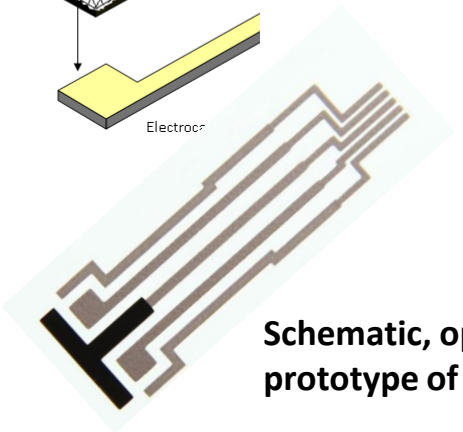


Glucose analysis





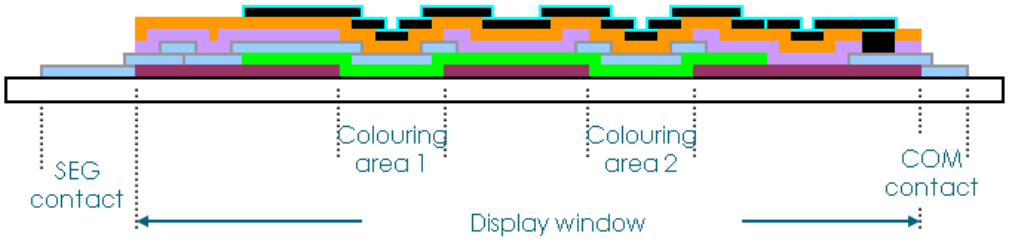
Cholesterol analysis



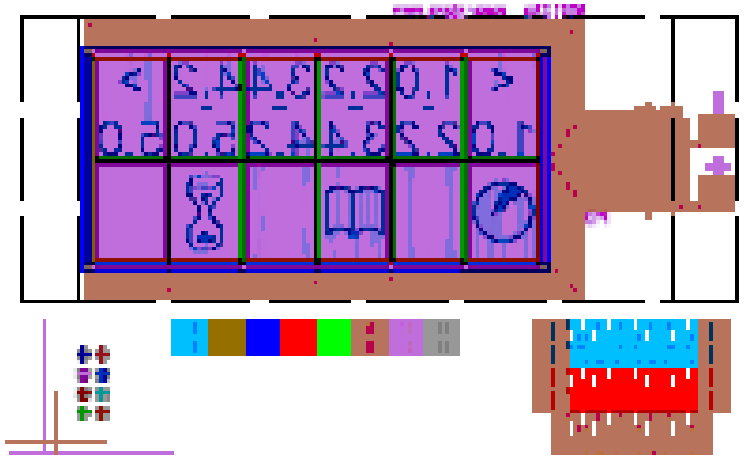
Schematic, operation and prototype of SIMS biosensor

The display

- Prototype screen printed displays have been developed
- Based on electrochromic technology
- Reduced layer stack developed for improved production
- Innovative display driver developed
- A series of display prototypes have been fabricated and tested



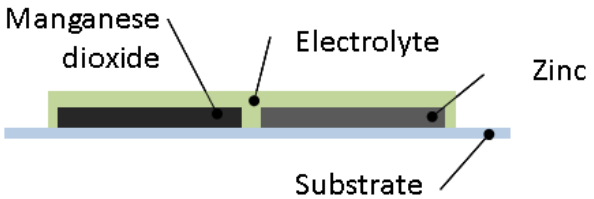
SIMS display layer stack



Prototype display designs

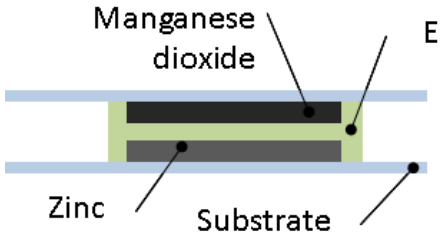
The battery

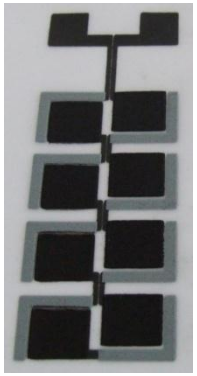
- The preliminary power requirements for the SIMS device have been defined – Display 3 V, Circuit/sensor +/-15 V
- An over-printable electrolyte has also been developed
- A prototype battery layout for SIMS has also been developed
- Prototype lateral and stack batteries have been fabricated

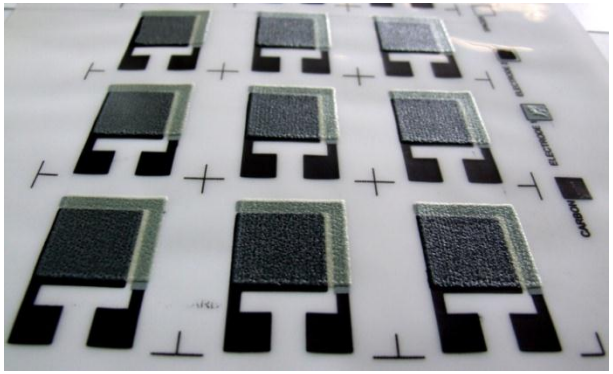


Lateral prototype

Stack prototype





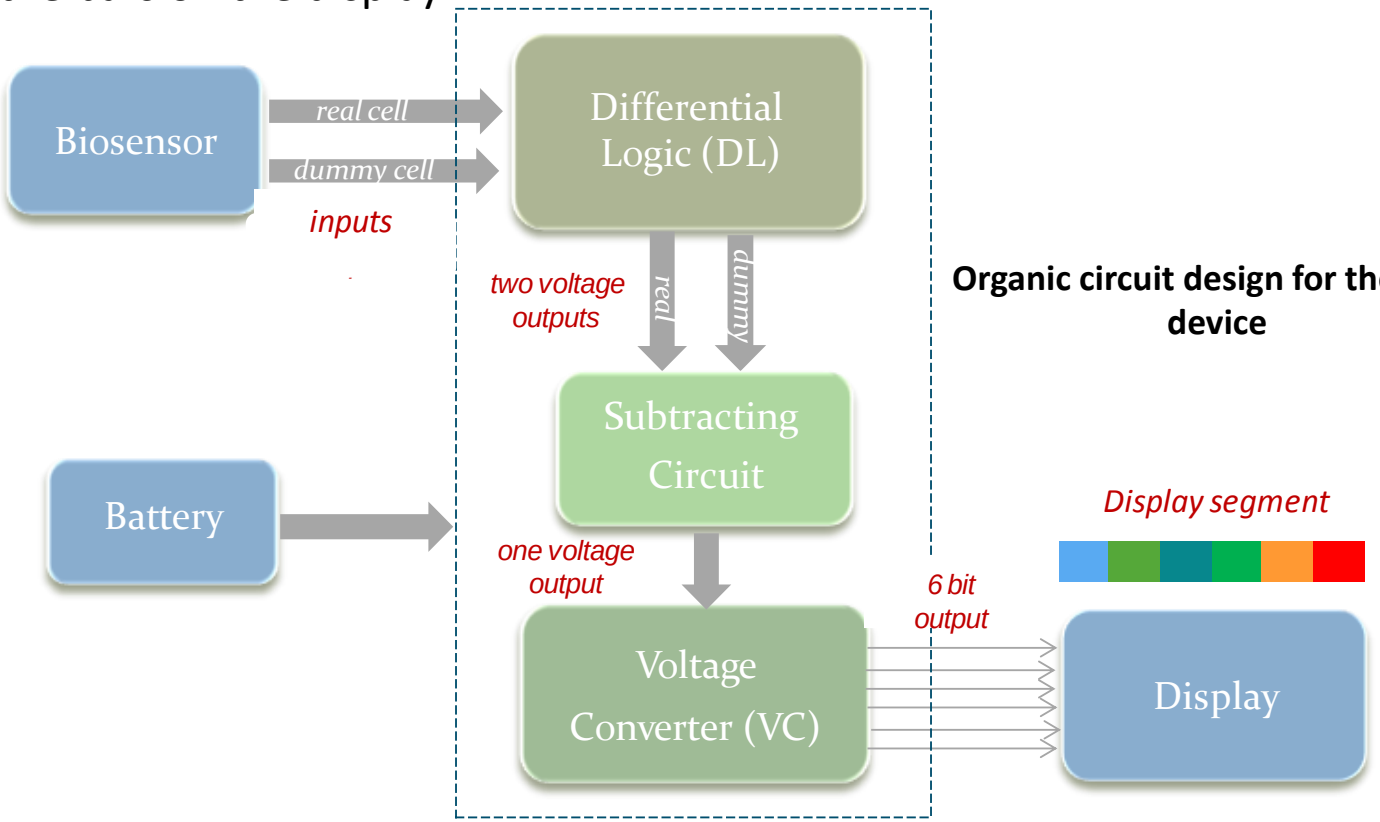


Prototype lateral, stack and multi-cells

SIMS battery layout

The organic circuit design

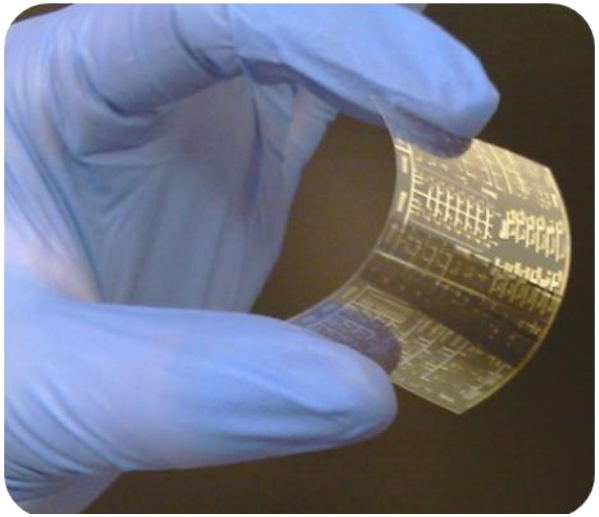
- A novel organic circuit design has been specifically defined and developed for the SIMS device
- Converts difference between test and control sensor output into a voltage output that drives the bars on the display



Organic circuit design for the SIMS device

The organic circuit production

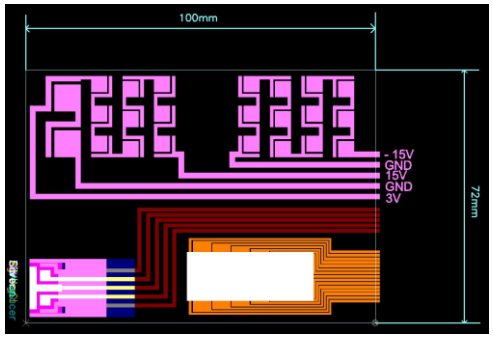
- The pseudo-PMOS (p channel) circuits were simulated to optimise circuit design and performance
- Circuit fabrication is utilising superior self-aligned photolithographic processing
- Organic circuits consisting of the various functional blocks (differential dynamic logic, and voltage converter circuits) have been fabricated on plastic substrates and are undergoing optimisation



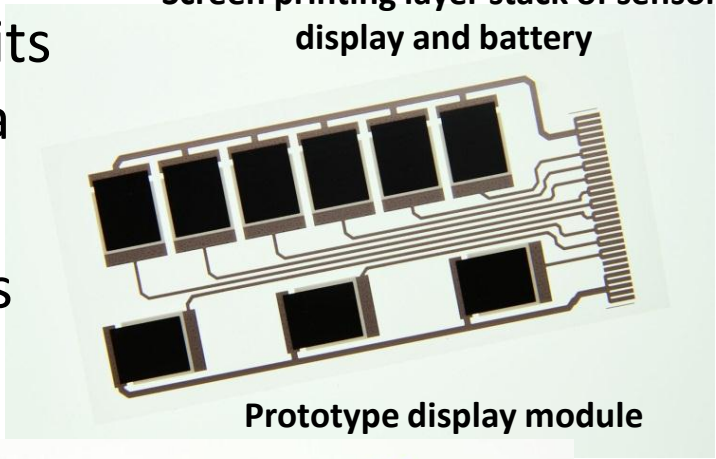
Prototype organic circuit functional blocks on flexible substrates

System integration

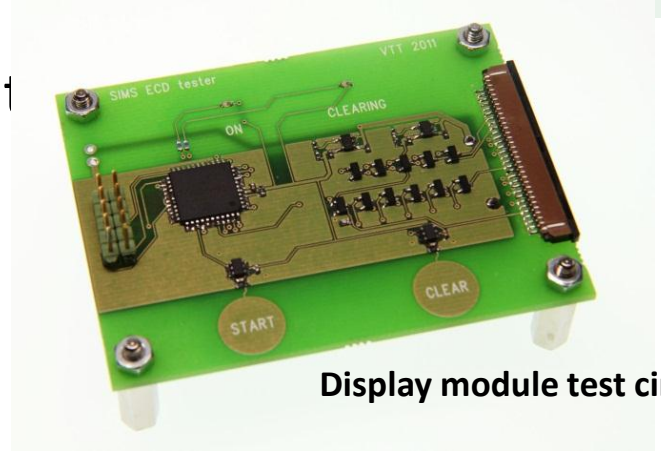
- A strategy for full systems integration has been developed
- Prototype sensors, displays and circuits have been successfully printed onto a common choice of substrate
- Design layouts for common processes (e.g., screen printing) have been developed
- System subcomponents are being t using silicon circuits



Screen printing layer stack of sensor, display and battery



Prototype display module



Display module test circuit

Summary

- The SIMS programme has made excellent progress in its first year in the development of system subcomponents
- Prototypes of sensors, displays, batteries and circuits have all been successfully fabricated on a common choice of substrate
- Components continue to undergo optimisation and are now being integrated onto a single platform
- Screen printed components (sensor, display and battery) are currently undergoing fabrication integration
- Sensor and display are about to be tested for functional integration using a simulated silicon circuit equivalent

Acknowledgements

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