UNIVERSITY of OULU
OULUN YLIOPISTO

OAMK
OULU UNIVERSITY OF APPLIED SCIENCES

VTT

OAMK

BioPrint projekti

Kolme painettua biosensorisovellusta

1. Glukoosisensori
2. Stressitesti – syljen α- amylaasin mittaus
3. Immunosensori – aineenvaihdunnan seurantaan

European Union
European Regional Development Fund

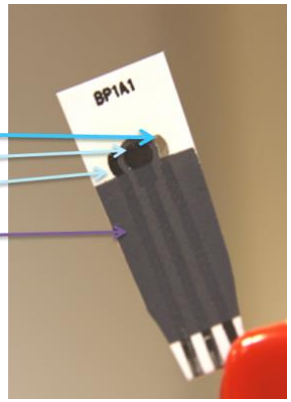
POHJOIS-POHJANMAAN LIITTO
Council of Oulu Region

Leverage from the EU
2007–2013

Silkkipainetut elektrokemialliset biosensorit

Screen printed electrode

- Silver/$AgCl_2$ reference eletrode, RE
- Carbon working electrode, WE
- Carbon counter elctrode, CE
- Dieletric insulating layer

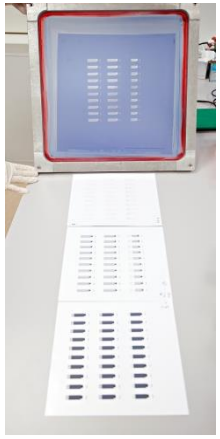


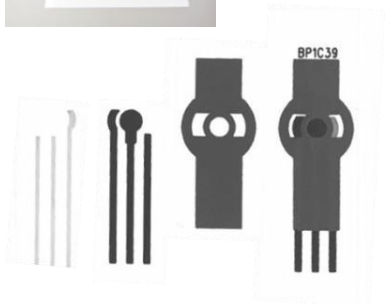
Painettujen sensoreiden edut

- Massatuotanto mahdollista
- Kertakäyttöisiä
- ➡ point-of-care/on-site-test
  - Helppoja käyttää, nopeat tulokset

Biosensor test strip manufacturing process

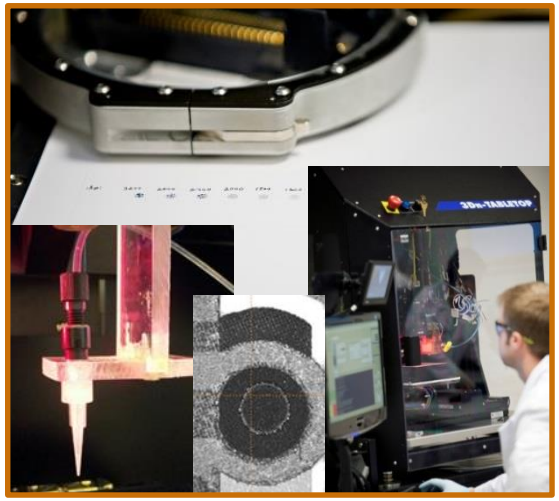
1. Screen printing of electrodes





1. Reference electrode, silver ink
2. Working electrode, counter electrode, graphite ink
3. Insulator layer
4. Ready electrochemical sensor with three overlaying layers

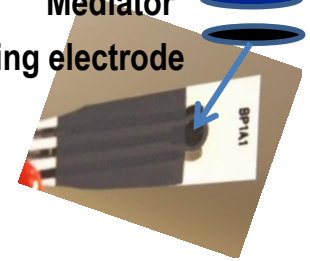
2. Dispensing biomaterial on the sensor



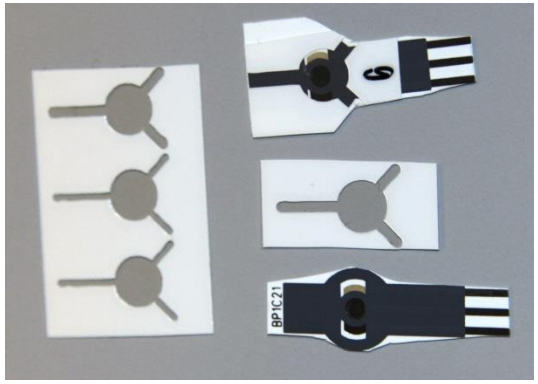
Bioinks (enzymes,stabilazers)

Mediator

Graphite working electrode



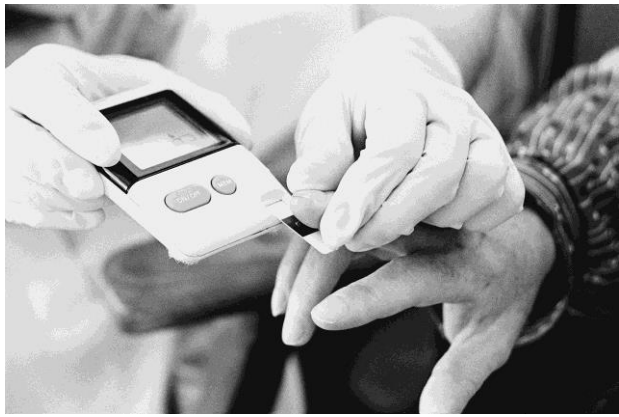
3. Covering sensor and attaching sample channels/cambers



Adhesive layers, Lamination, packaging

Application areas

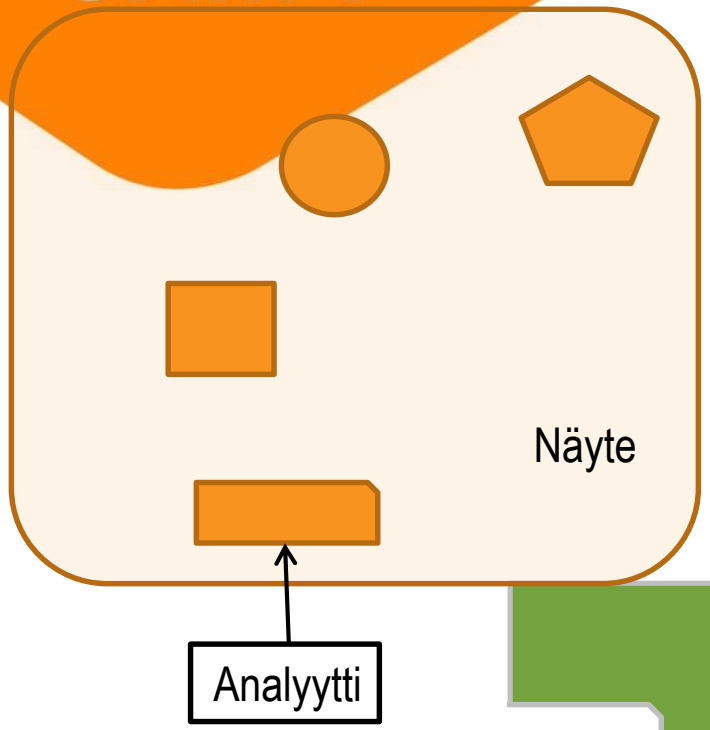
- Diagnostics:
  - POC for home use and clinical use
  - glucose, pregnancy, cholesterol, urea, lactate, cardiac markers, drugs…
  - glucose sensor strips on market 25 years
- environment
- food processing and safety
- wellness
- Drugs, alcohol
- Security/ military



Need for POC tests

- Rising healthcare costs
  - Centralized labs, early diagnosis demand, careful follow up
- Ageing population
- Demand for personalized medicine
- Environmental regulations

Biosensorin periaate



Elektrokemiallisessa biosensorissa tunnistusreaktio muunnetaan sähköisesti mitattavaksi. Mittaus perustuu yleensä hapetus-pelkistysreaktioihin, joka on suhteessa analyytin määrään.

Biomolekyyli tunnistava elementti

Esim. entsyymi, vasta-aine, hormonireseptori…

Signaalin välitys

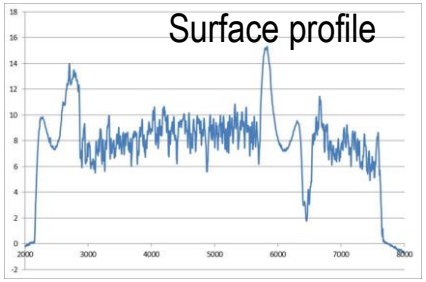
Esim. sähkökemia, värireaktio, fluoresenssi, lämpö….

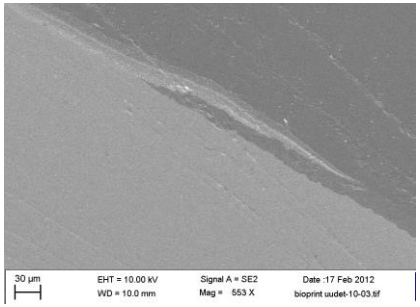
Mitattava signaali

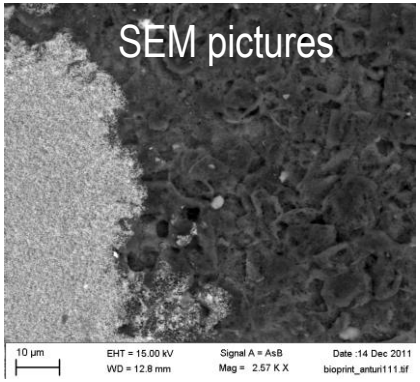
Testing of biosensors: quality control, functionality, reproducibility

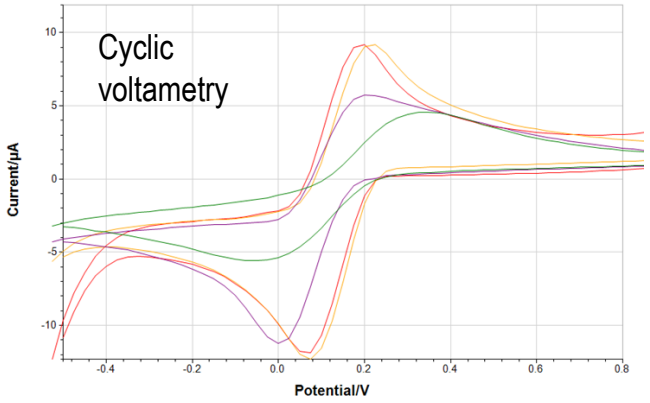
Materials and printing
- Conductivity
- Light microscopy
- Surface profiles
- Scanning electron microscopy

Functionality
- Electrochemical methods
  - Cylic voltametry
  - Amperometry









Printable analytics

Electrochemical sensors

Examples:

- Blood glucose test
- Pregnancy test
- Cholesterol
- Cardiac markers
- Lactate

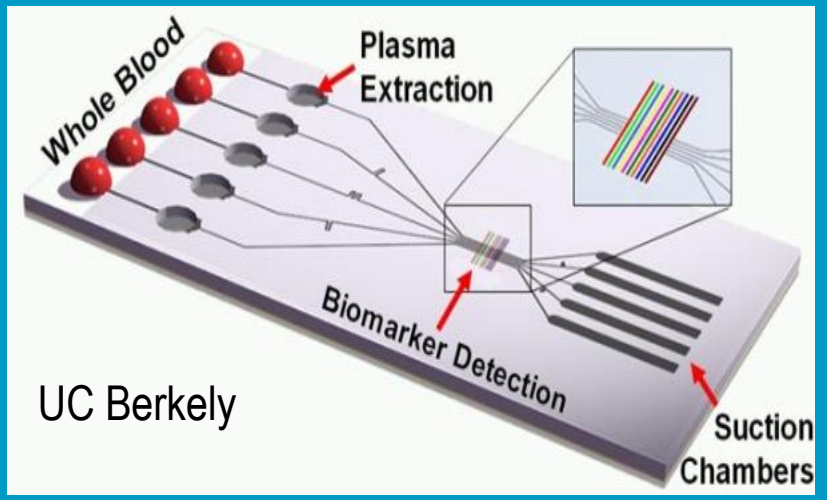
Blood glucose test

Clean Card/
Orion Diagnostica

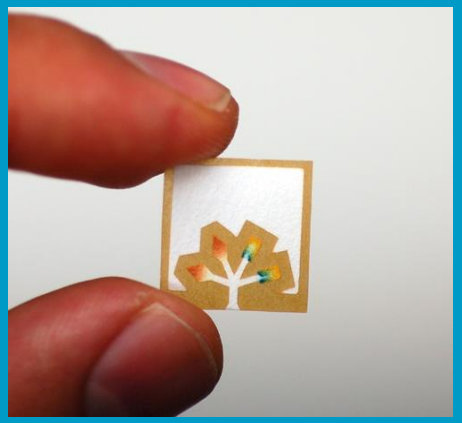
Colorimetric/ lateral flow tests

Nissinen/BioPrint

Microfluidistics/fluorecense/ colour detection



UC Berkely



Paper+ wax channels+colour reaction/Whiteside lab

Epoc blood analysis system/
Epocal

PrintoCent pilot factory concept

Roll to Product

- R2R functionality testing
- Component assembly
- Injection moulding

R2R Pilot production

- Pilot production for components, products and systems
- Multilayer printing in register
- Product testing and characterising

Up-scale to R2R

- Ink tuning for R2R process
- R2R printing trials
- Layer and component prototyping and testing
- R2R process development

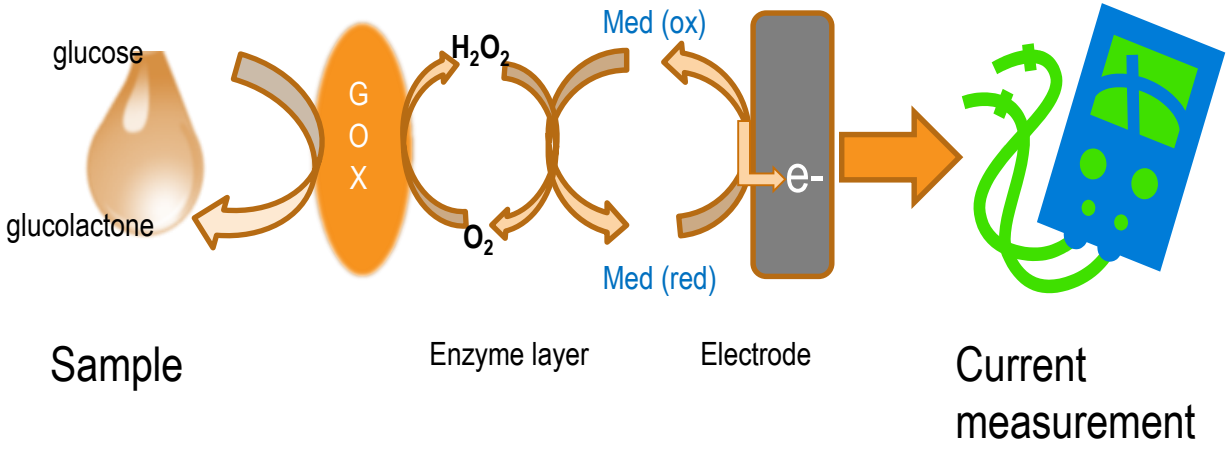
R&D at the research laboratories

- Material research, development and testing
- Printing tests with different techniques
- Layer and component characterisation
- Application development
- Demonstrator manufacturing

Glukoosisensorin toimintaperiaate

1. Glukoosisensori

Testimenetelmä

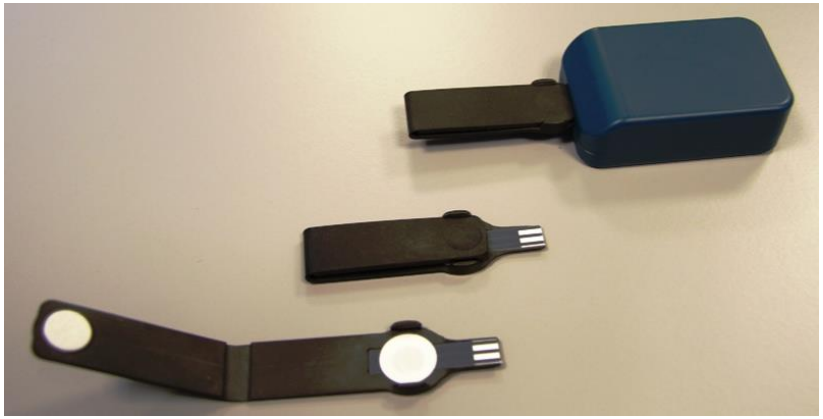


GOX- entsyymi, joka sitoutuu näytteen glukoosiin spesifisesti ja auttaa sitä muuttumaan glukolaktoniksi

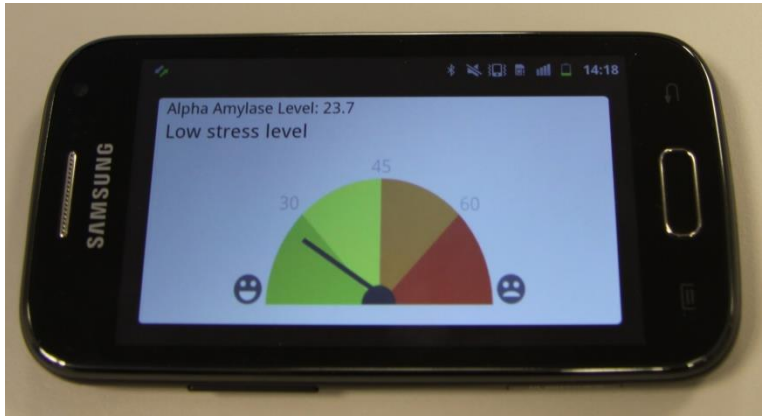
25 billion glucose test strips sold 2012
IDTech

Stress test demonstrator – funded by Start&Run project

Detection method: enzymatic and amperometeric- measured current is propotional to activity of saliva α-amylase.
Results can be send to cloud for personal stress profile.

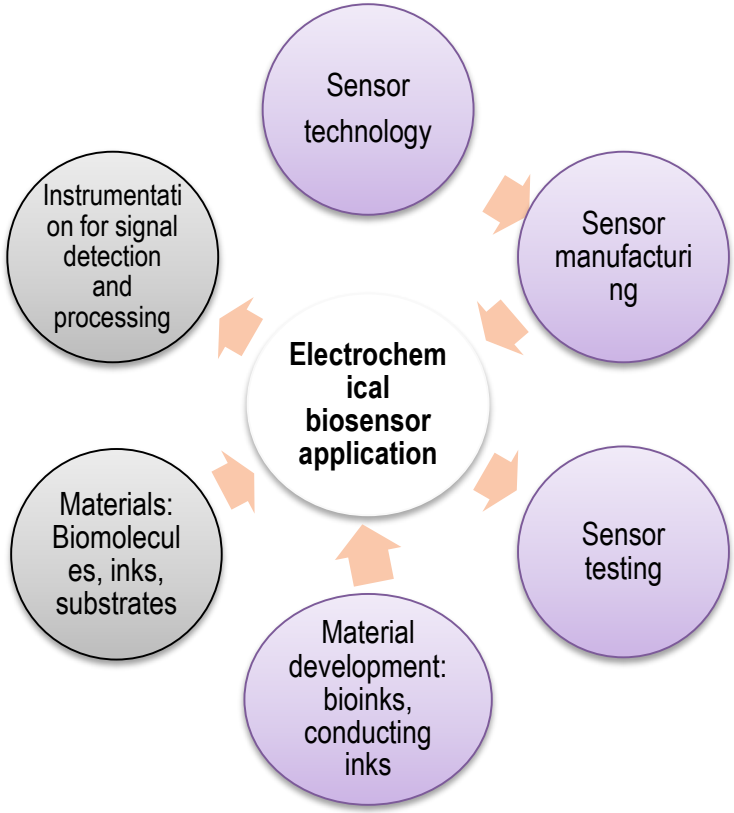


Sample collector , printed amylase sensor and amylase reader. Design Cemis-Oulu, GIN, iSTOC, OUAS



Result is shown in the mobile phone with graphics and number . Developed by iStoc Ltd.

Steps to the biosensor application prototype



BioPrint- printed electrochemical sensor development platform

Key questions for the application idea:

- What to detect?
- How to get the sample to the recognizing element?
- How to detect/recognize: reaction?
- What is the signal from reaction and how to detect?
- **Are there markets for the application?**