

Printed biosensing platform integrated in recycled paper

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MOTIVATION

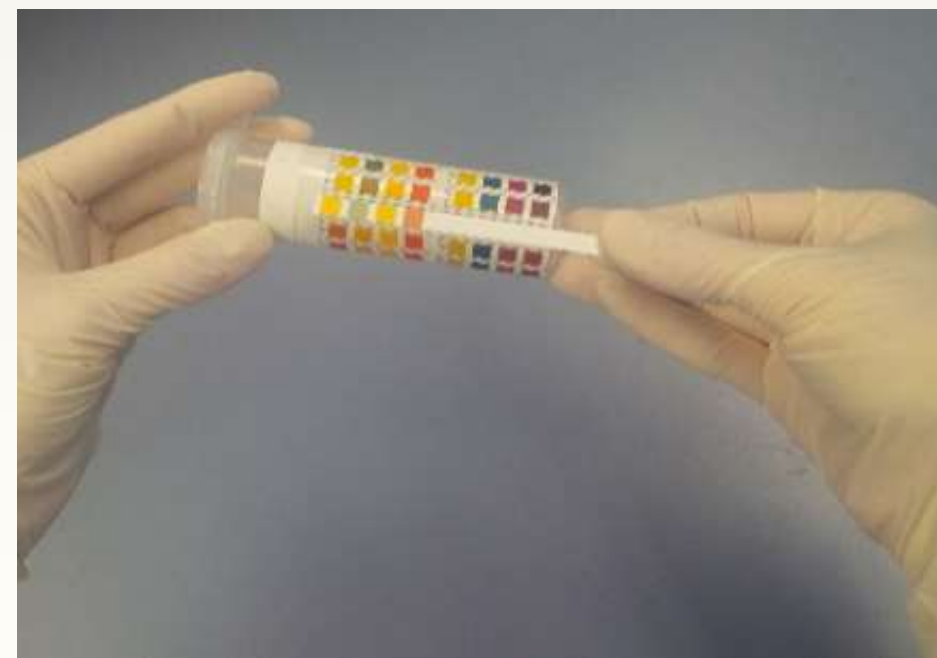
The **decentralization of the health care system**, driven by the demographic change, creates a strong demand for sustainable **high volume and low cost biosensors** that enable molecular diagnostics outside of laboratories.

To **overcome these limitations**, we aim to realise an electrochemical **single-use sensor**, which i) is based on **recycling paper** as substrate to enable environment-friendly production and disposal, ii) detects quantitatively glucose and ketone bodies in urine to permit the diagnosis of ketoacidosis, iii) is able to contactless communicate the measured values.

State of the art: Single-use test strips using color indicators

Urine test strips

- Plastic substrate
- Subjective visual perception
- No electronic data recording
- Detect only acetoacetic acid



➔ No present point of care system can detect beta-hydroxybutyric acid and acetoacetic acid



Paper manufacturing

- Cellulose matrix for biofunctionalisation
- Surface for electrodes



Roll-to-roll printing

- Electrodes
- Hydrophobic barriers



Microelectronics

- Printed antenna
- Assembly of bare dies

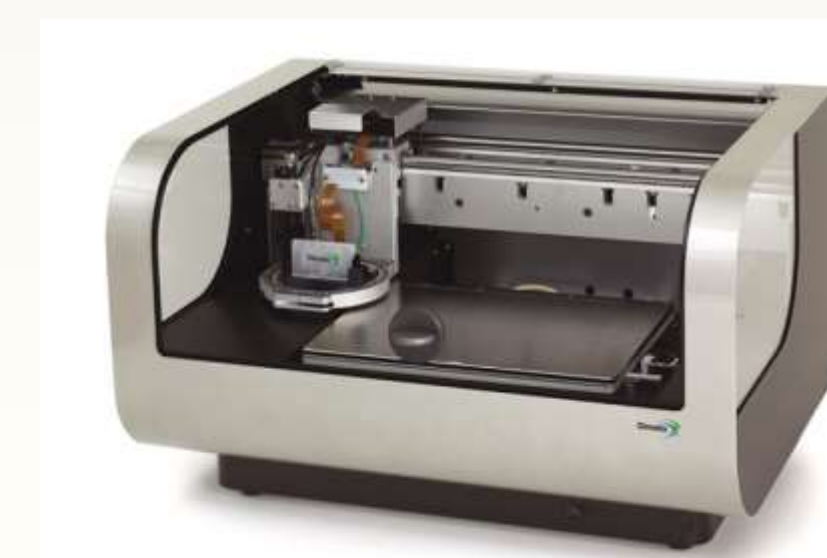
Electrochemical biosensing for the quantification of glucose and ketone bodies (beta-hydroxybutyric acid and acetoacetic acid)

PIONIER demonstrator

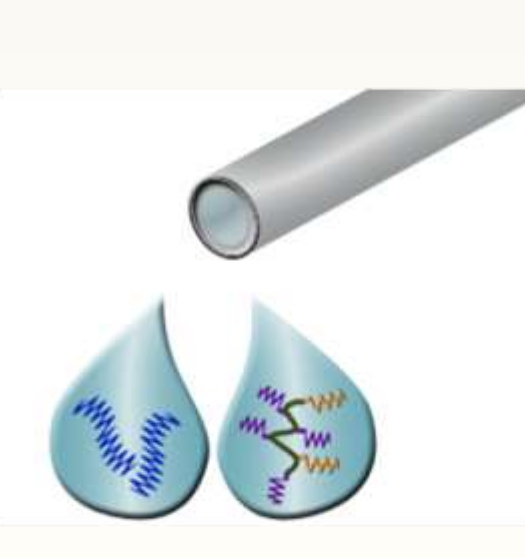
- Paper substrate
- Quantitative results
- Contactless read-out
- Battery-free
- Automatic data recording
- Environment-friendly

Single step biofunctionalisation

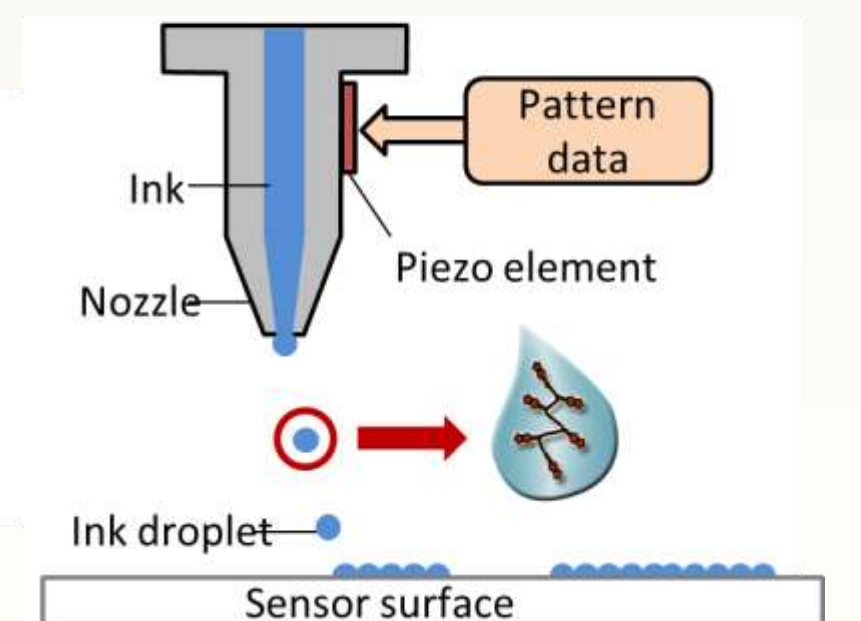
Material inkjet printer



Printable bioink formulation

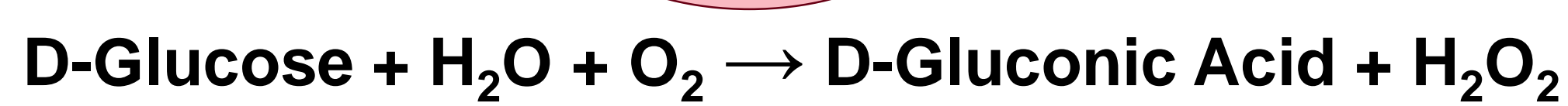


Direct bioink printing process

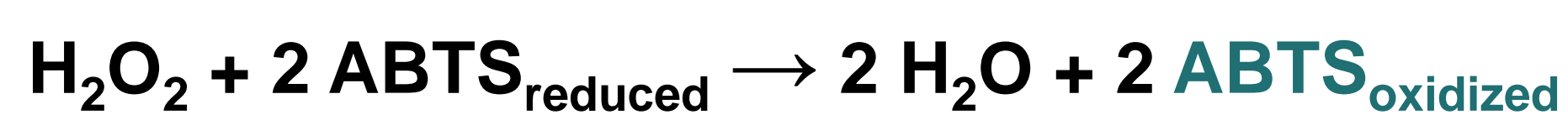


Enzyme assay

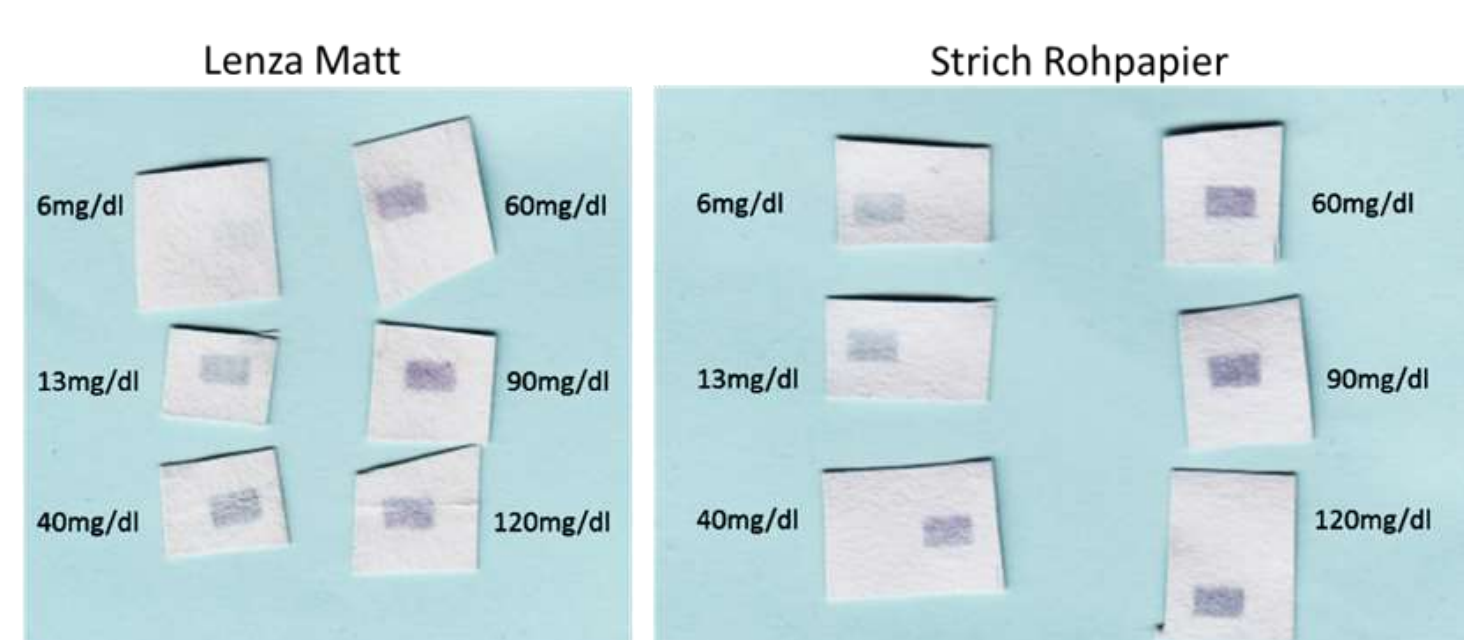
Glucose oxidase



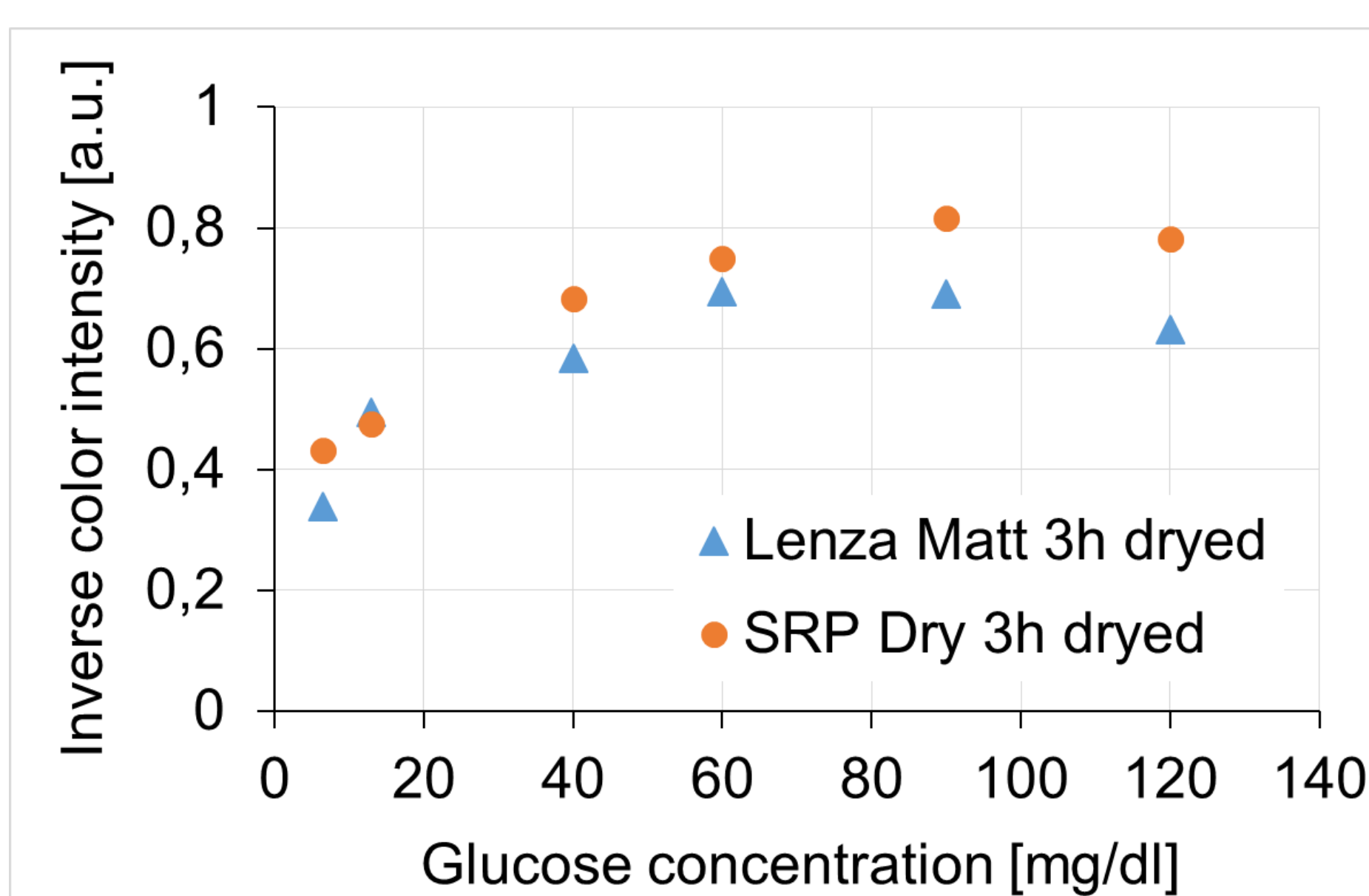
Peroxidase



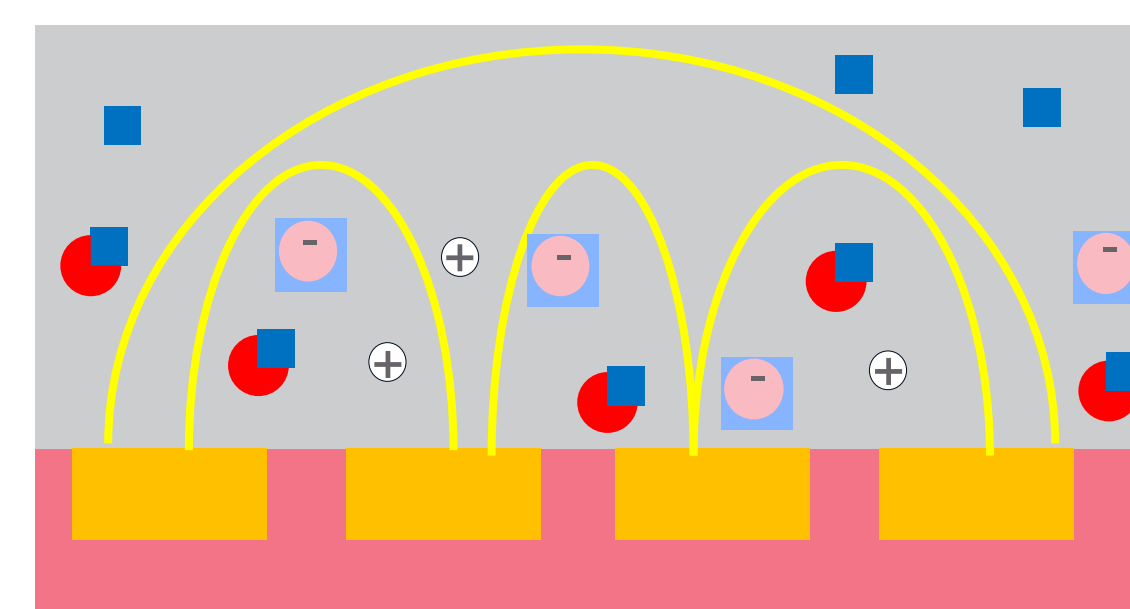
Different glucose concentrations



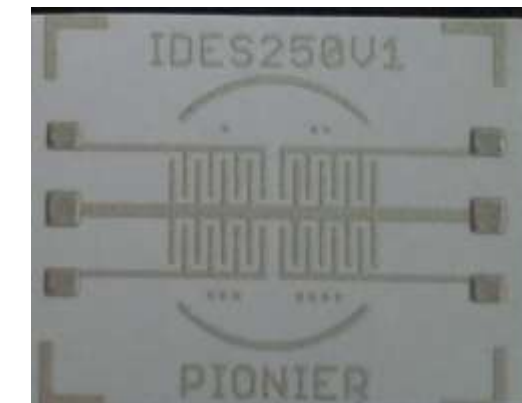
Quantification of glucose in recycled paper



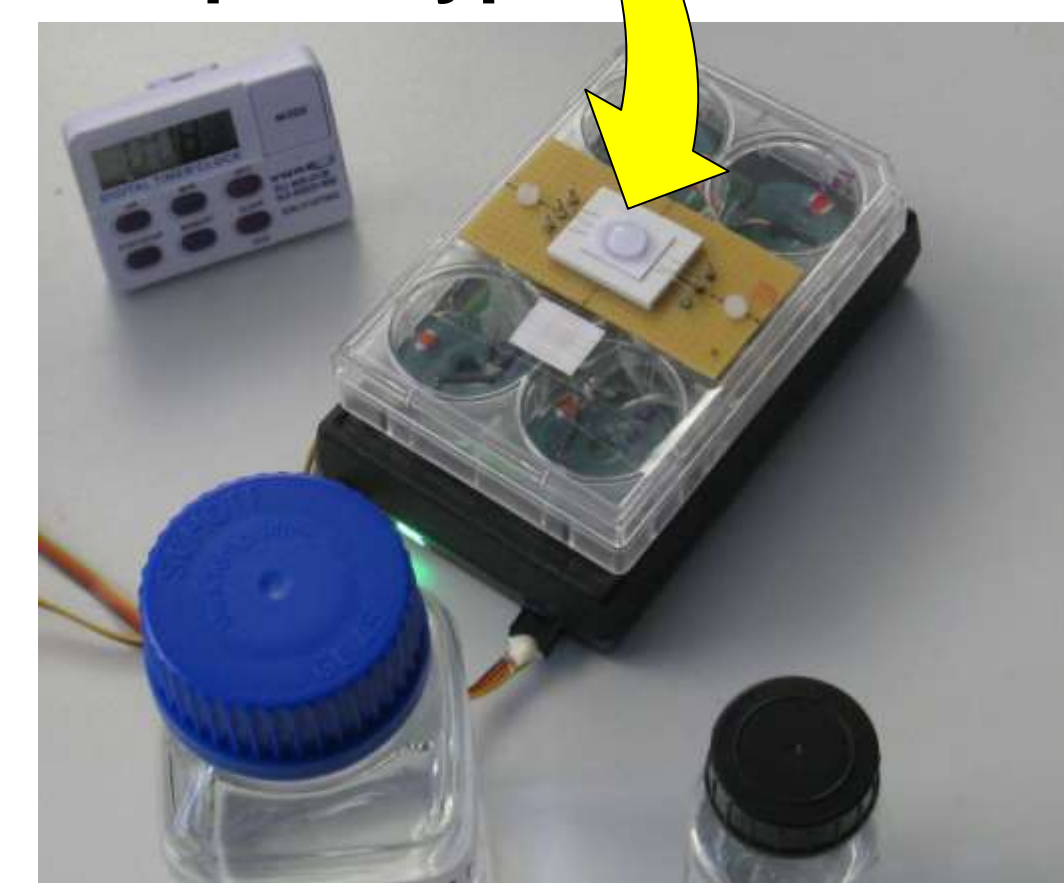
Biosensing



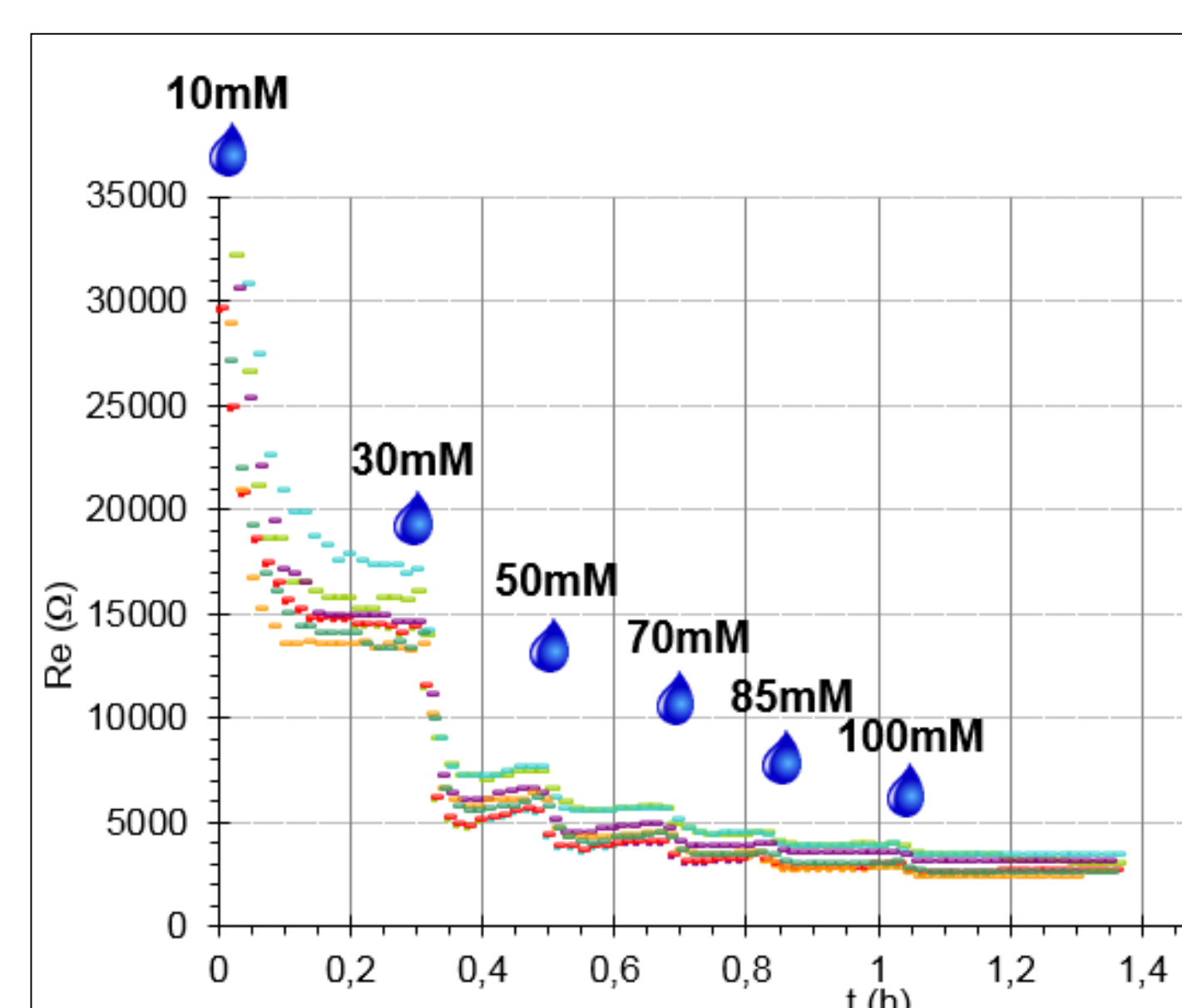
Paper sensor



Lab prototype

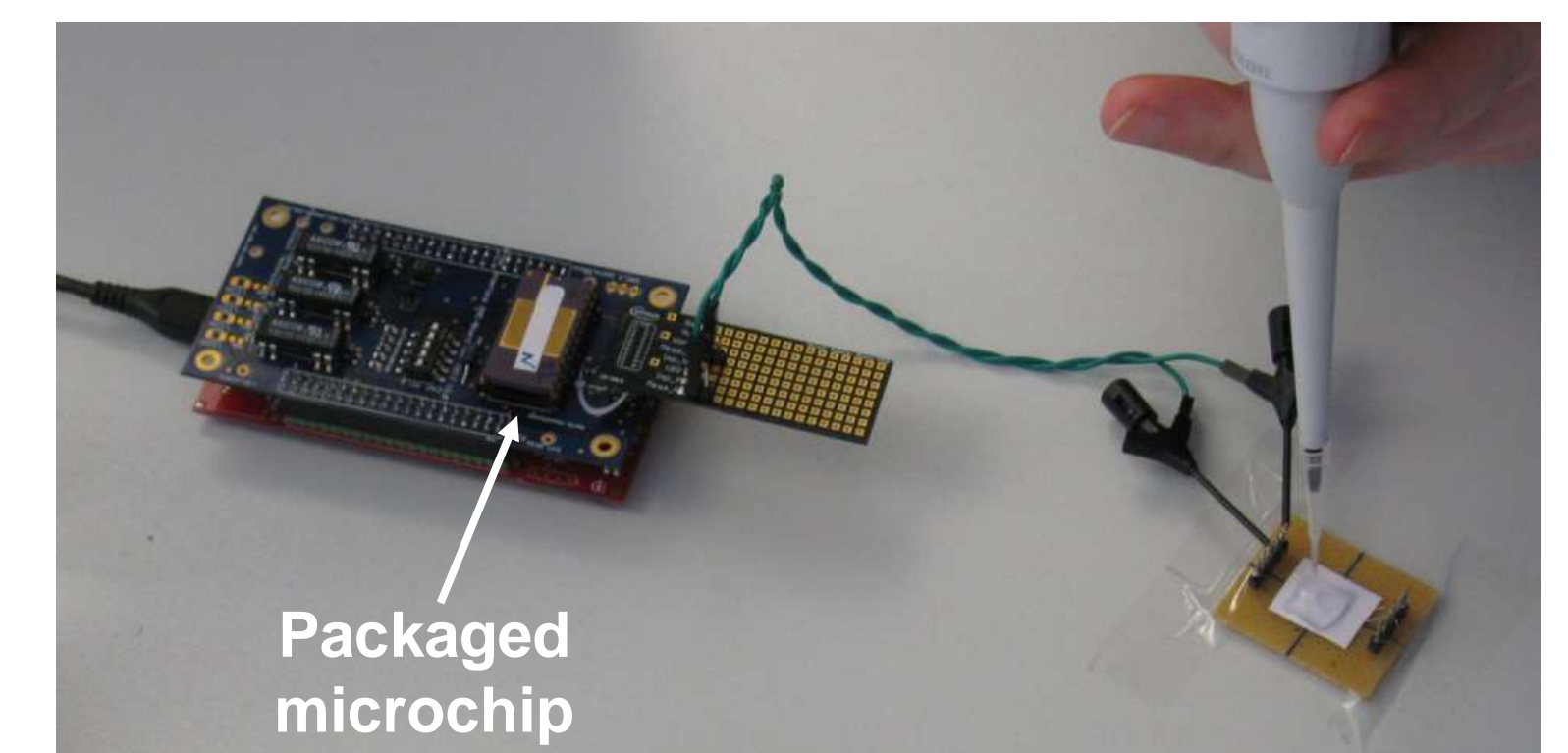


NaCl conductivity test



PIONIER integration levels

USB connected read-out



Wireless NFC read-out



Packaged microchip

Outlook: Full integration on paper
- Unpackaged microchip
- Wireless NFC read-out

