

Paper-based printed platform for electrochemical biosensing

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MOTIVATION

Due to the rapid development in the areas of "Internet of Things" and ubiquitous sensor networks, more and more products with a short period of usage are emerging. In this context, aspects of **environment-friendly production and disposal** are becoming increasingly important. Particular attention has to be put on **single-use** products that are produced in **very large volumes**. Especially in this area, the paper and printing industry already has long standing expertise.

At present, non-invasive point-of-care rapid tests are mostly available in the form of test strips using color indicators. The reading of these test strips is strongly influenced by the subjective visual perception and the results are, therefore, only qualitative.



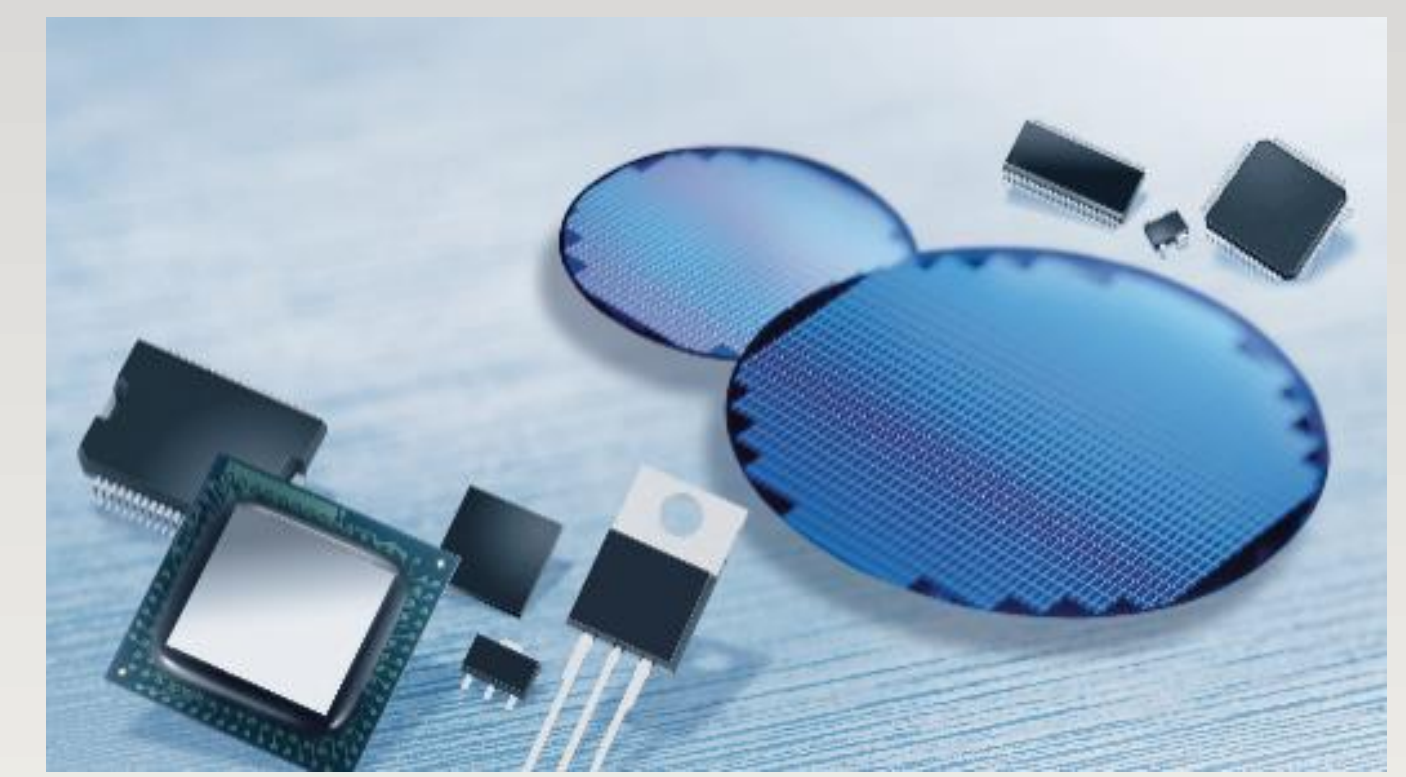
Paper manufacturing

- Cellulose matrix for biofunctionalisation
- Surface for electrodes



Roll-to-roll printing

- Electrodes
- Hydrophobic barriers

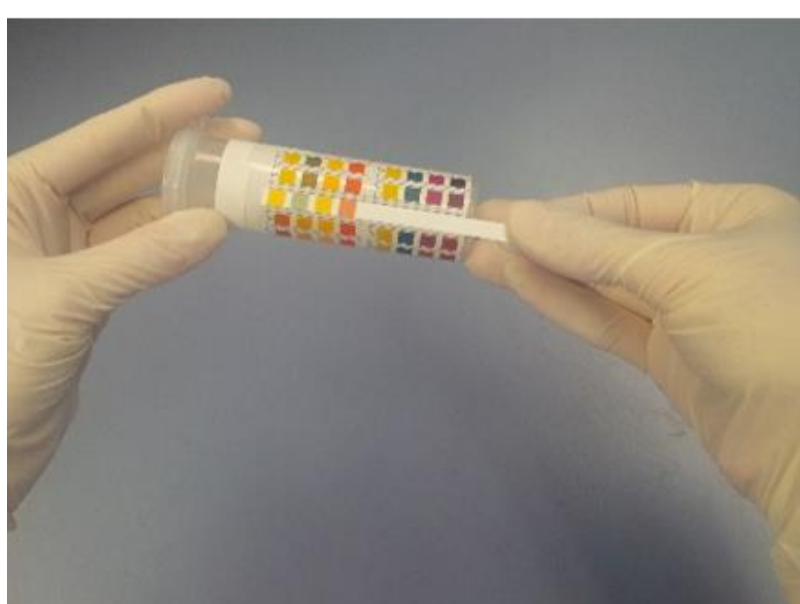


Microelectronics

- Printed antenna
- Assembly of bare dies

Innovation example

State of the art



Urine test strips

- Plastic substrate
- Subjective visual perception
- No electronic data recording
- Not suitable e.g. for ketoacidosis



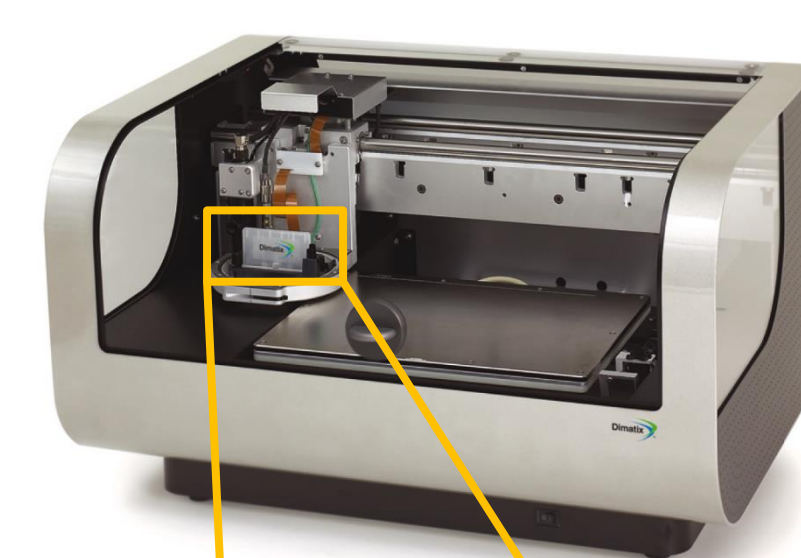
Electrochemical biosensing
for the **quantification of**
glucose and ketone bodies
(beta-hydroxybutyric acid and
acetoacetic acid)

PIONIER demonstrator

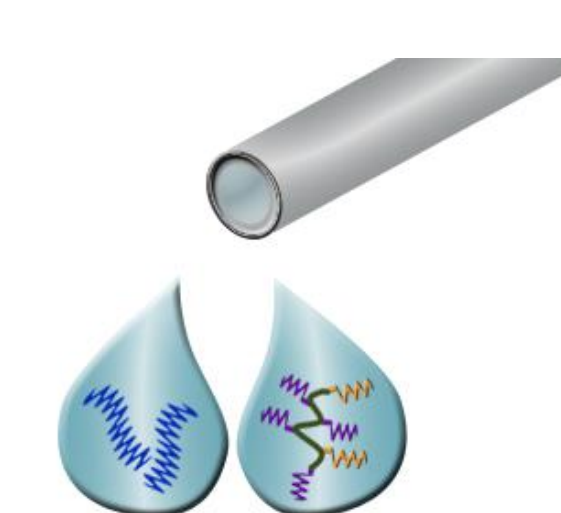
- Paper substrate
- Quantitative results
- Contactless read-out
- Battery-free
- Automatic data recording
- Environment-friendly

Single step biofunctionalisation

Material inkjet printer



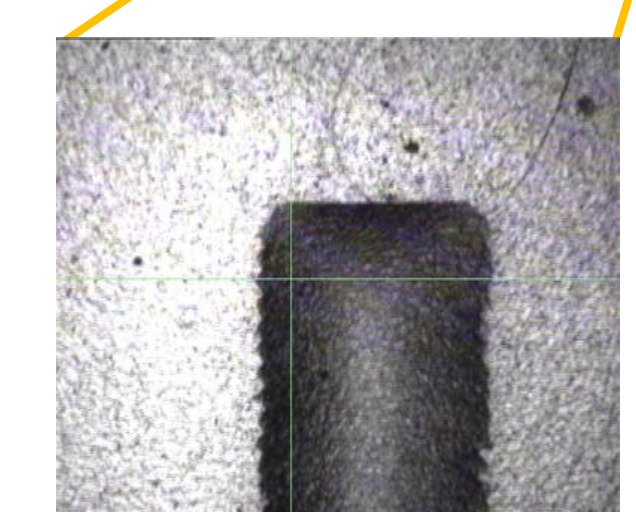
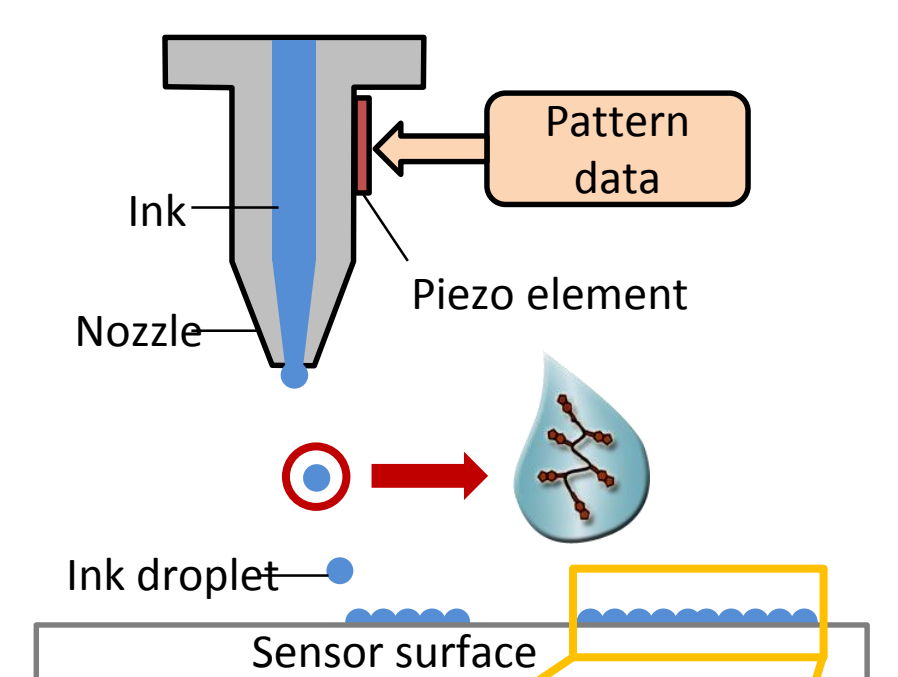
Printable bioink formulation



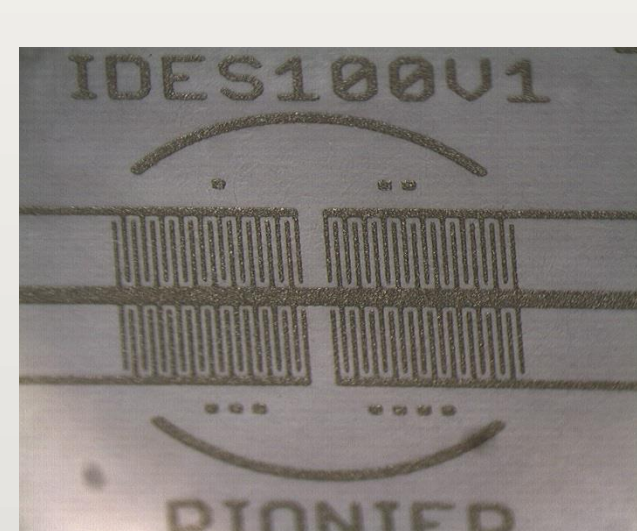
Key properties

- Viscosity
- Surface tension
- Biomolecule stability
- Chemical reactivity

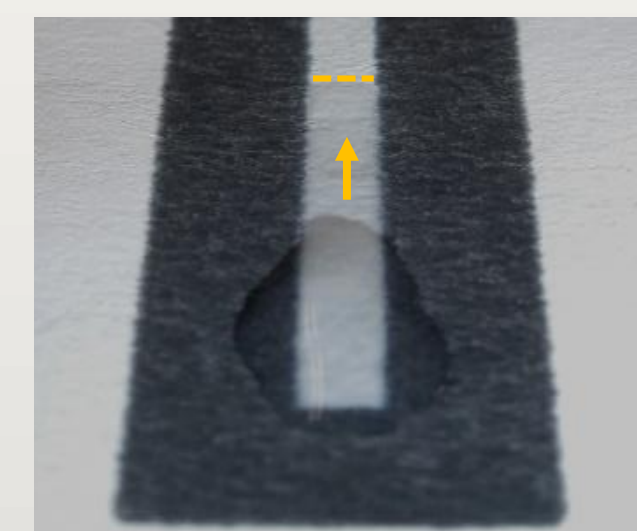
Direct bioink printing process



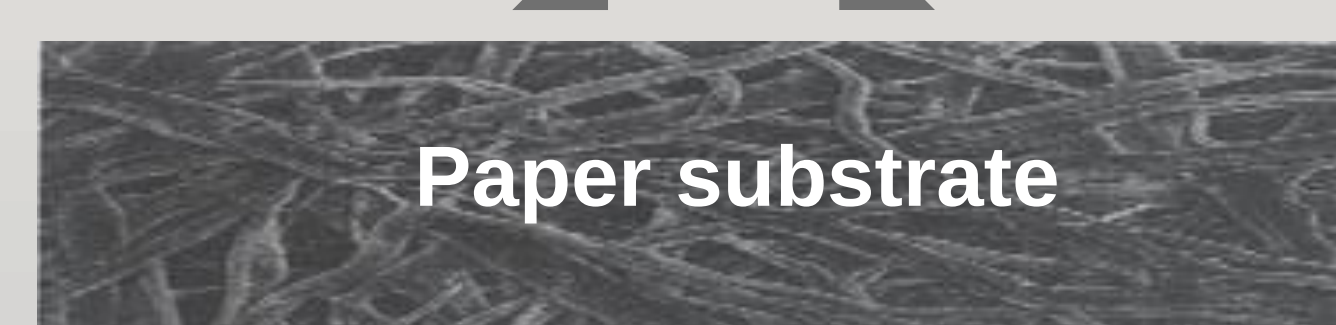
Integration



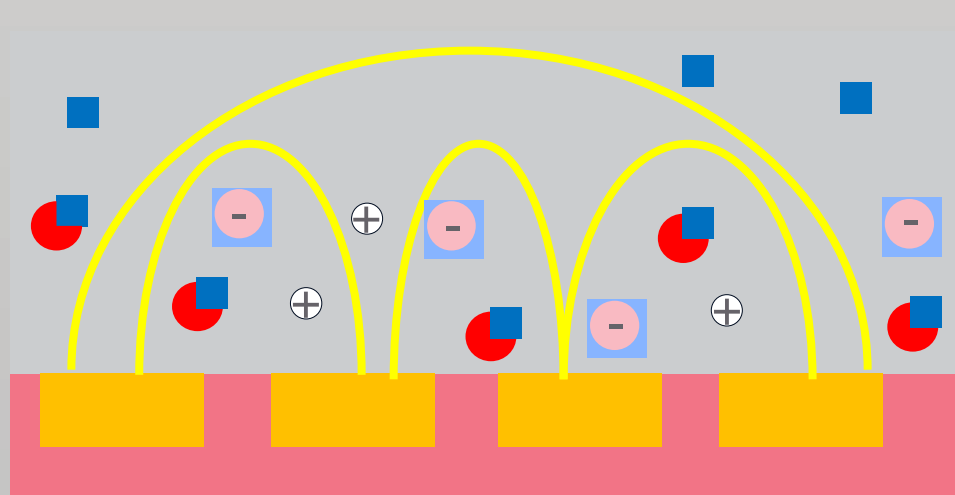
Electrodes



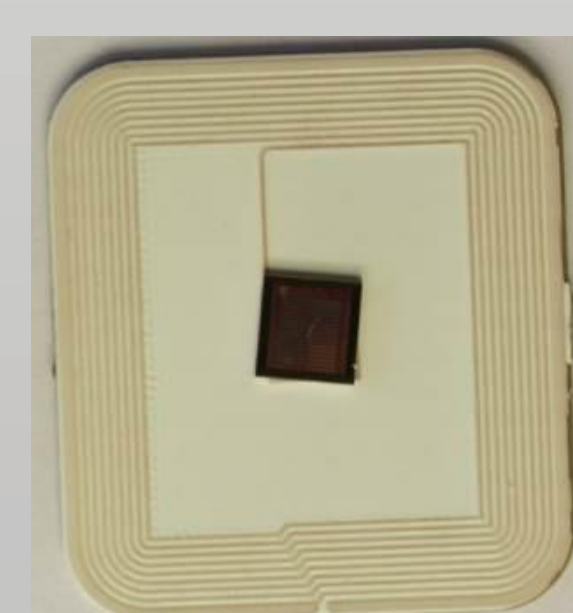
Microfluidic



Paper substrate



Biosensing



Battery-free
contactless readout

METHODOLOGY

We explore the **integration of different processes to develop a paper-based biosensor platform for molecular diagnostic systems**. For this purpose, suitable fabrication processes are developed: printing of electrodes, bioinks and hydrophobic barriers. The readout of the measurement values is accomplished contactless by integrating a small, battery-free near field communication (NFC) chip. This important aspect plays an essential role for environmentally disposal.

Silver printing on paper

