Next Generation Sustainable and Functional Electronic Components and Systems

SusFE

Aim: Develop functional electronics for *green and circular economy with R2R manufacturing for wearable and diagnostic devices*

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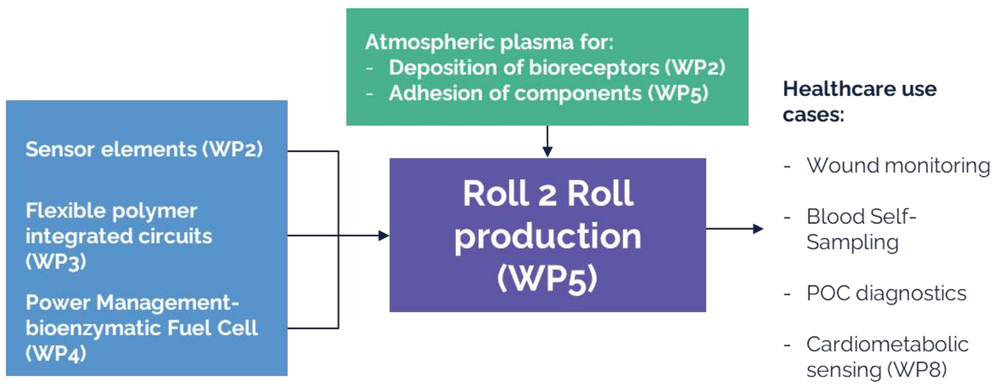
Objectives:

- ❖ Flexible integrated circuits (FlexIC) on polymer substrates for implementing electronic functions
- ❖ Recyclable bio-enzymatic fuel cell as power source
- ❖ Cold atmospheric plasma to allow tailoring of surfaces for joining and deposition of bioreceptors
- ❖ Roll-to-Roll (R2R) fabrication for point-of-care (POC) diagnostics, blood self-sampling, wound monitoring and cardio-metabolic wearable.



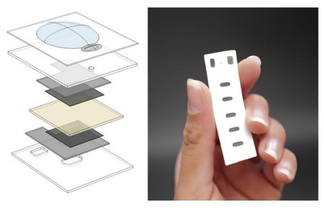
1. SusFe Toolbox

1.1 Analogue & Digital Circuitry on Polymer (FlexIC)

- ❖ Developing FlexICs for electronic functions for sensing applications
- ❖ More sustainable than rigid silicon integrated circuits (ICs) and conformable

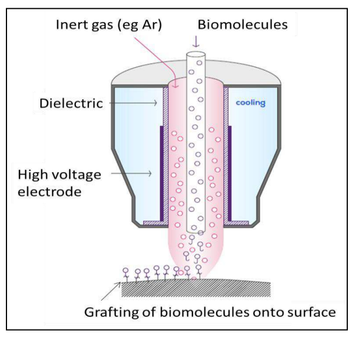
1.2 Bioenzymatic fuel cell

- ❖ Enzyme integrated on carbon electrode for conversion of glucose and oxygen to provide organic energy solution that is compostable.
- ❖ Comparable energy density and improved power density compared with printed alkaline technologies



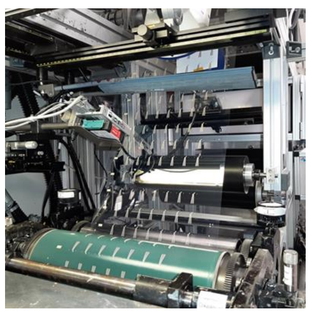
1.3 Cold atmospheric plasma for surface tailoring

- ❖ Modification of plasma power, feed gas and process temperature can be used for treatment of substrates
- ❖ Used for joining of different layers and deposition of bioreceptors



1.4 Roll-to-Roll (R2R) fabrication

- ❖ Mass-manufacturing compatible approach using R2R with suitable dispensing, lamination and cutting methods using biodegradable and sustainable materials along



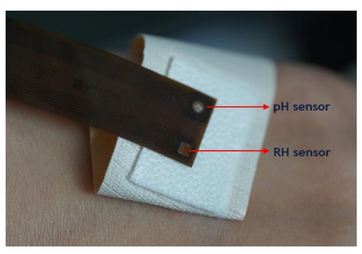
1.5 Textile integrated electronics

- ❖ Flexible and stretchable printed electronics integrated into textile garments for wearables.
- ❖ Additive manufacturing methods for biomedical electrodes and sensors focusing on sustainability.

2. SusFE Use Cases

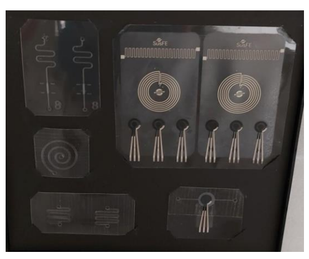
2.1 Wound Monitoring

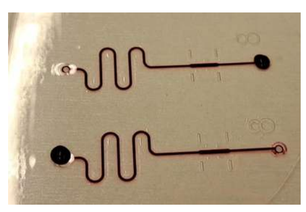
- ❖ The wound monitoring patches consist of a reusable part (fuel cell battery, RFID,...) and a disposable part (integrated with pH and humidity sensor)
- ❖ The disposable part of the wound monitoring patches was fabricated via standard photolithography in roll-to roll method on the commercial polyimide flexible foil.



2.2 Point-of-Care Diagnostic

- ❖ Sustainable microfluidics, R2R screen-printed electronics, and electrochemical sensors mass-produced into biodegradable materials (e.g., R2R manufactured PLA films) utilizing greener chemicals and sustainable-by-design techniques
- ❖ Integration of other SusFE toolbox components for self-powered electrochemical multiplexed detection of sepsis from blood.



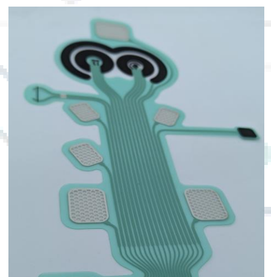


2.3 Self-sampling of blood

- ❖ The sampling card consist of a microfluidic laminate enabling passive removal of red blood cells from finger prick blood and metering of the generated plasma/serum.
- ❖ Integration of electrodes, bioenzymatic fuel cell and FlexIC in the card enables registration of time of sampling and wireless transmission of sampling signal through RFID tag for use in therapeutic drug monitoring in clinical trials and health care.

2.4 Cardio-metabolic wearable

- ❖ Multimodal sensing from a textile integrated electrode array
- ❖ Leveraging data fusion for increased reliability of feature extraction
- ❖ Modular approach with configurable architecture for personalised solutions
- ❖ Cross domain applicability



3. Expected Impacts

- ❖ We will develop low-cost diagnostics to address the increasing healthcare costs within industrialised countries and lack of resources within Low Medium Income Countries
- ❖ POC diagnostics and wearable devices for rapid and continuous data for management of health
- ❖ Moving diagnostic systems towards use of more sustainable materials and processes for reducing the carbon footprint and improve circularity.

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