# Autonomous biosensor for screening breast cancer biomarkers using passive Fuel Cells

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## Introduction

The goal of this PhD plan is to develop novel biosensors for cancer screening that will be integrated into a passive fuel cell to produce a self-powered device. To this end, two major fields of research are combined: Biosensors and Fuel Cells. A material that acts as an antibody-like recognition material is used as the biosensor - shown in Figure 1 - and direct methanol fuel cells (DMFCs) are used to give the biosensor autonomy - shown in Figure 2. The combination of these two elements involves mounting the plastic antibody inside or outside the fuel cell, using suitable carriers for both options.

Several cancer biomarkers are selected for the development of the Molecularly Imprinted Polymers (MIPs)/plastic antibodies, directly or indirectly involved in prostate cancer diseases, which may be modified considering new research developments regarding this type of biomarker.

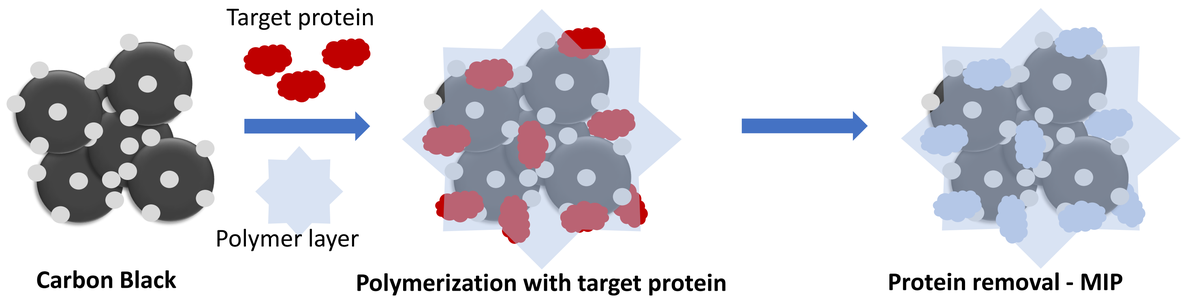



**Figure 1** – Scheme of the MIP production on the conductive/catalytic matrix used in DMFCs.

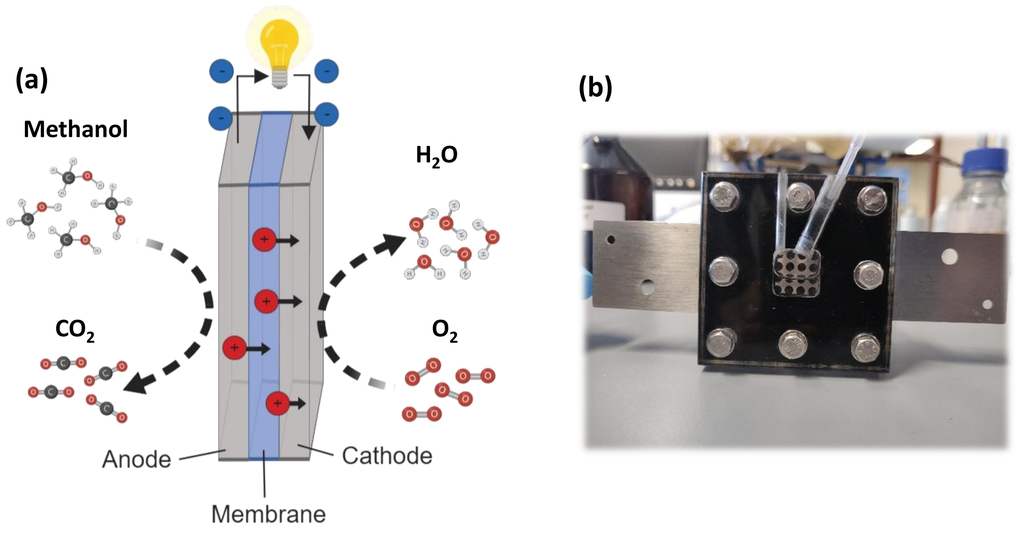



**Figure 2** – **(a)** Representation of the MEA and the reactions occurring in both anode and cathode of the DMFC; **(b)** DMFC used for this work.

## Methodology

✓ Development of MIPs for selected biomarkers

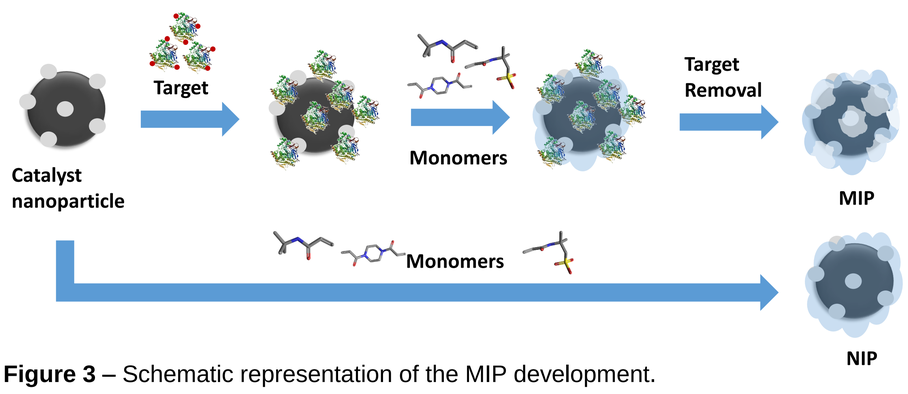



**Figure 3** – Schematic representation of the MIP development.

✓ Calibration procedure of the biosensor in the DMFC, having standards incubated there and monitoring the subsequent electrochemical output on a potentiostat

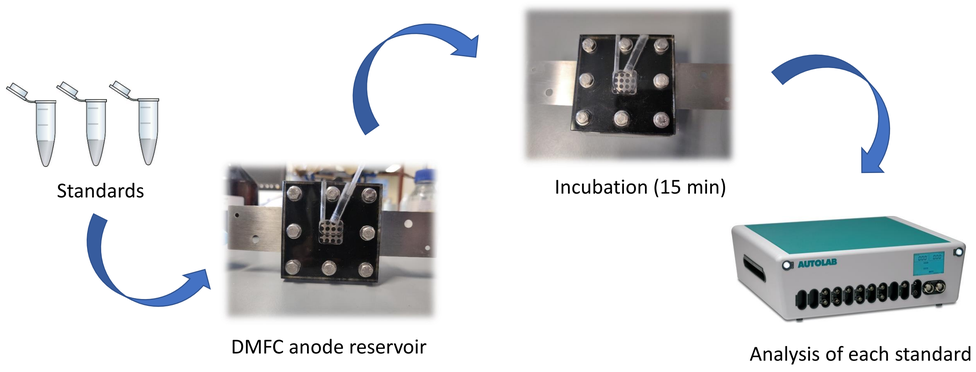
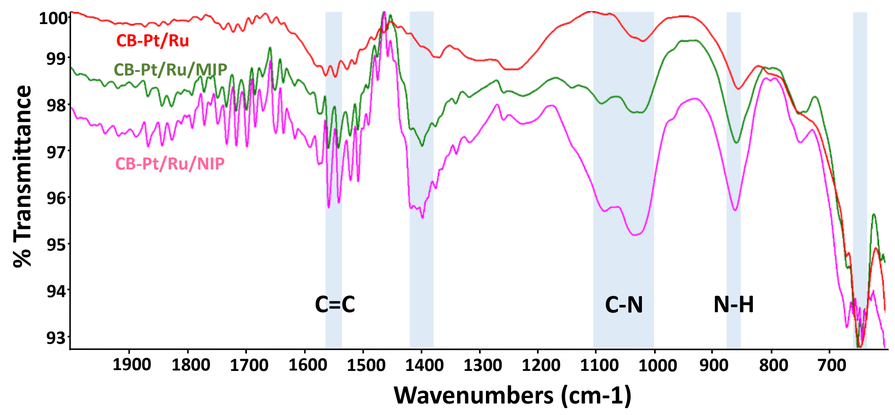



**Figure 4** – Calibration procedure of the biosensor in the DMFC.

## Results

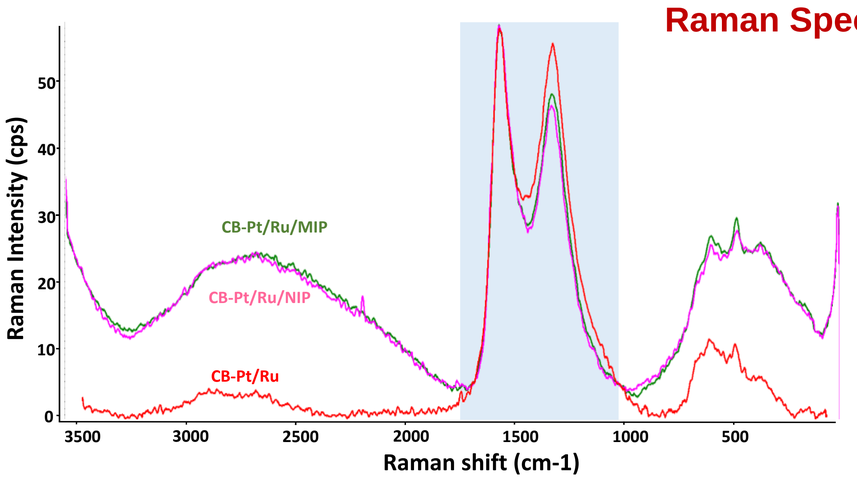
### FTIR Analysis

FTIR spectra of different materials used to assemble the MIP, confirming the expected chemical modifications.




### Raman Spectroscopy Analysis

Raman spectra also confirmed the chemical changes occurring in the synthesis of the MIPs.




### Calibrations in buffer

The MIP device displayed a decreasing trend of the power, with the increasing concentration of the analyte, with a linear range from 3.2 to 2000 µM.

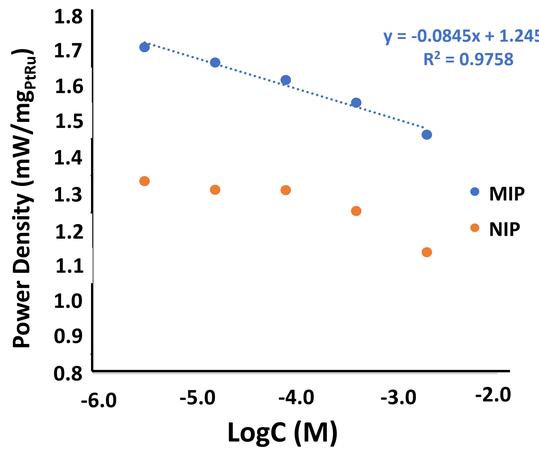



**Figure 7** – Calibration curve of MIP and NIP in buffer.

## General considerations

The work under development aims an autonomous biosensor for the detection of cancer biomarkers. New plastic antibodies for cancer biomarkers are being developed and optimized for best response. Furthermore, the DMFC is assembled, tested and adjusted to the best performance needed for the main objective of this work plan.

## Acknowledgements

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