ENHANCED DETECTION WITH PRUSSIAN BLUE-BASED NANOCUBES: A NOVEL ELECTROCHEMICAL BIOSENSOR FOR BOVINE SERUM ALBUMIN ANALYSIS: MICROFLUIDIC INTEGRATION

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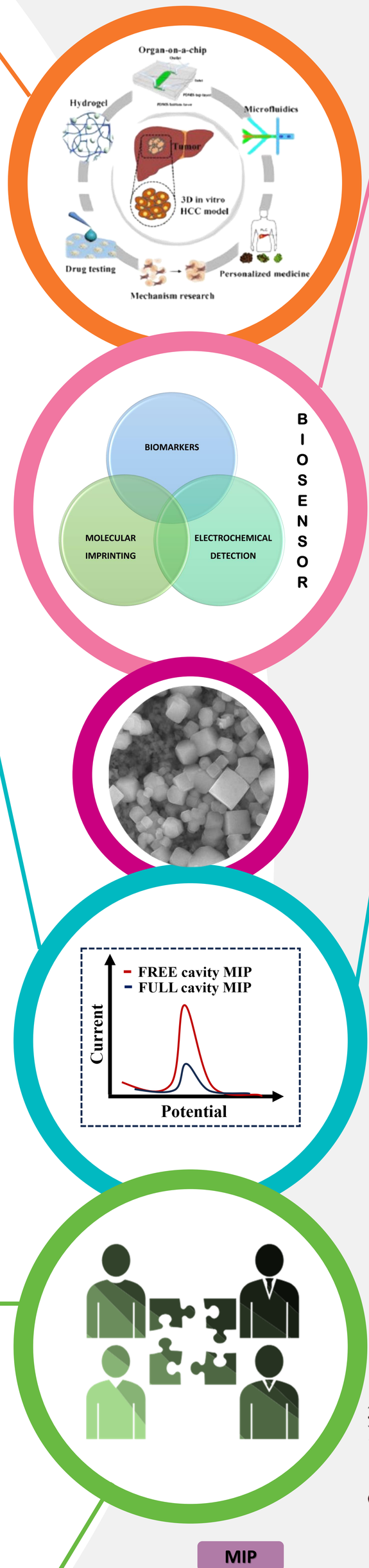
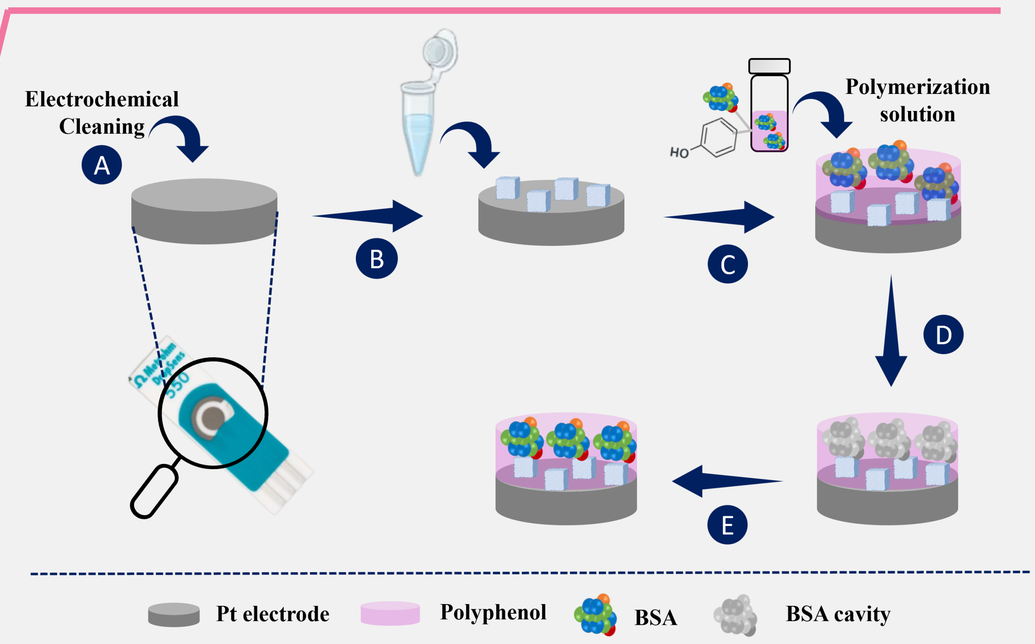
INTRODUCTION

Early diagnosis of biomarkers is crucial for optimizing treatments and increasing survival rates. Direct and cost-effective assays are important for point-of-care (PoC) testing. Bovine serum albumin (BSA) monitoring indicates liver and kidney function and aids in the assessment of diseases such as cirrhosis and chronic kidney disease [1. 2].

An innovative electrochemical biosensor was developed in which a platinum electrode was decorated with manganese-based Prussian blue nanocubes (PB-NC). A molecularly imprinted polymer (MIP) was created on the electrode surface by electropolymerization of phenol in the presence of BSA using cyclic voltammetry (CV). The template was removed with proteinase K and a mixture of methanol and acetic acid. Square wave voltammetry (SWV) characterized the performance of the sensor, which exhibited high sensitivity and allowed detection of BSA at nanomolar levels.



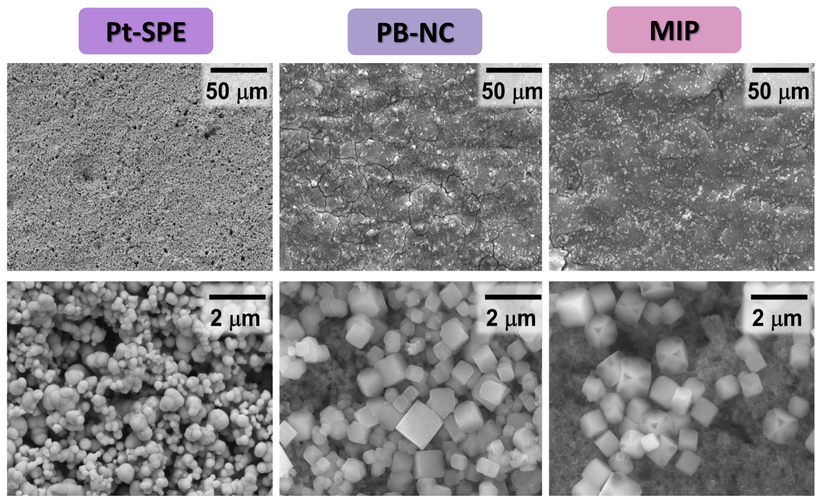
METHODOLOGY



Schematic representation of a MIP for the detection of BSA: (**A**) pretreatment of the working electrode; (**B**) drop-casting of the manganese-based Prussian blue nanocubes; (**C**) electropolymerization of a solution containing BSA protein and monomer (phenol); (**D**) removal of the BSA protein from the polymer matrix; (**E**) template binding on the MIP surface.

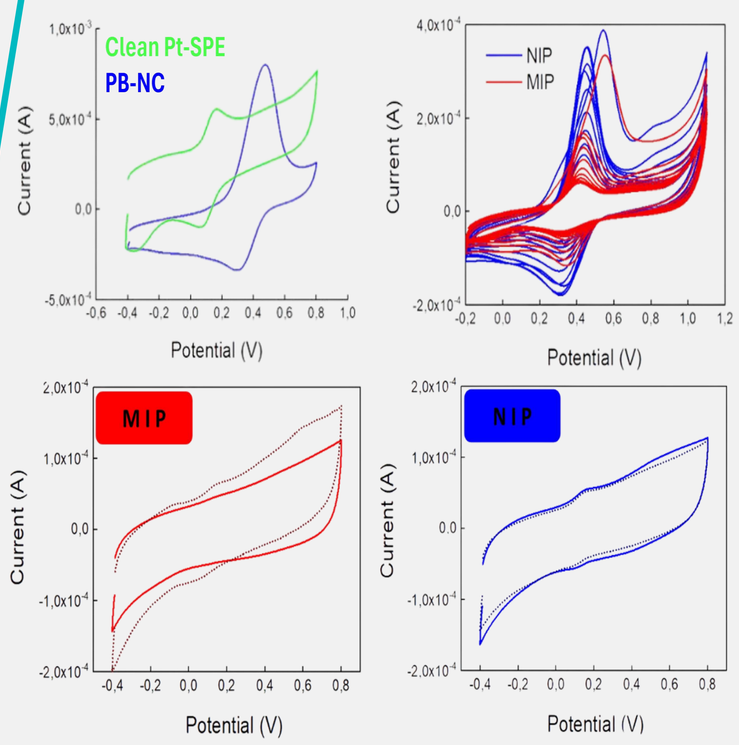
RESULTS

Surface modification characterization



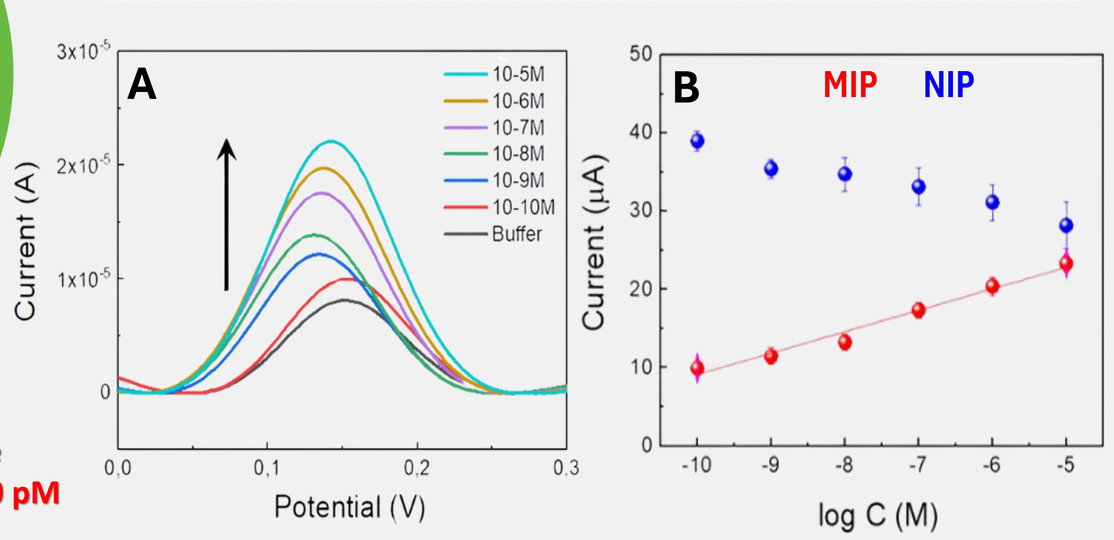
✓**The SEM technique shows the presence of PB-NC on the surface of the electrode and again a polymer layer modified with MIP, which is slightly modified with the nanomaterial on the surface.**

Electrochemical assembly of the BSA biosensor



- **The PHENOL oxidation peak indicates polymer formation, confirmed by the continuous decrease in current in the subsequent CV cycles.**
- **MIP has a lower current than NIP, suggesting that the presence of proteins during the polymerisation phase of MIP influenced this result.**
- **The target molecule is removed from the polymeric matrix, forming the imprinted cavities. This is confirmed by the increase in current after exposure to the removal agent.**

Analytical performance of the biosensor



Calibration of the BSA protein biosensor in fetal bovine serum (**A**) MIP SWV plot; (**B**) Calibration curve for MIP and NIP at different concentrations prepared with FBS, using relative SWV data.

GENERAL CONSIDERATIONS

The biosensor developed showed good analytical performance.

MIP showed superior sensitivity to NIP, suggesting specific sites for detection.

Linear response range of the biosensor: 100 pM to 100 µM.

The low cost and fast response make this biosensor a promising and easy-to-use tool for monitoring BSA in PoC tests.

MIP

✓**Good response over the concentration range 100 pM to 100 µM**

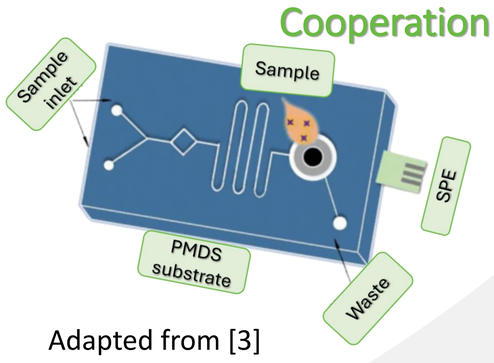
✓**Higher sensitivity**

✓**Improved linearity**

FUTURE PERSPECTIVE

Microfluidic integration

Cooperation with B-Flow



Adapted from [3]

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