Controlled block copolymers applied to molecular imprinting: a new generation of biosensors

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Introduction

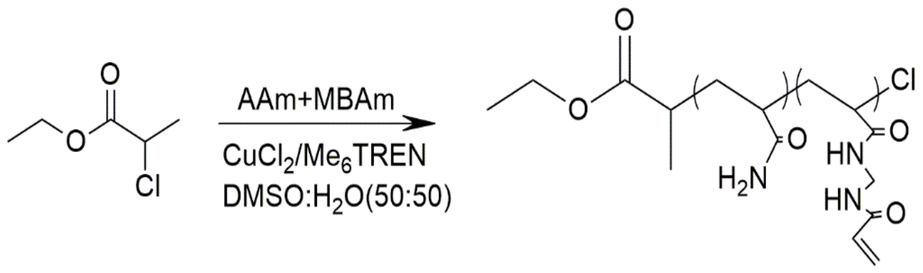
Cancer is a public health problem worldwide. In developed countries, it is estimated that one in three women and one in two men will develop cancer during their lifetime. Early detection is therefore necessary to improve survival indicators and there is an urgent need to develop non-invasive, simple and low-risk methods for cancer diagnosis. In the hospital context, immunoassay-based diagnostic methods (such as ELISA, using natural antibodies) are predominant.

Biosensors are now an alternative to immunoassays and open up new expectations for point-of-care analysis. These require a biorecognition element with suitable selectivity, low cost and high stability to meet current requirements in point-of-care diagnostics. Molecularly imprinted polymers (MIPs) could be used for this purpose, but limited selectivity is currently the bottleneck for their widespread use.

Therefore, the aim of this plan is to develop a new generation of MIP materials by using tailored block copolymers (BCs) synthesized by reversible deactivation radical polymerization (RDRP). These are grafted onto a conductive surface and further crosslinked in the presence of a protein. These RDRP technologies allow precise control over the structure, composition, molecular weight and end functionalities of the block copolymers. The structures of the new block copolymers have been carefully designed for perfect interaction with different protein domains (hydrophilic and hydrophobic), allowing precise molecular imprinting.

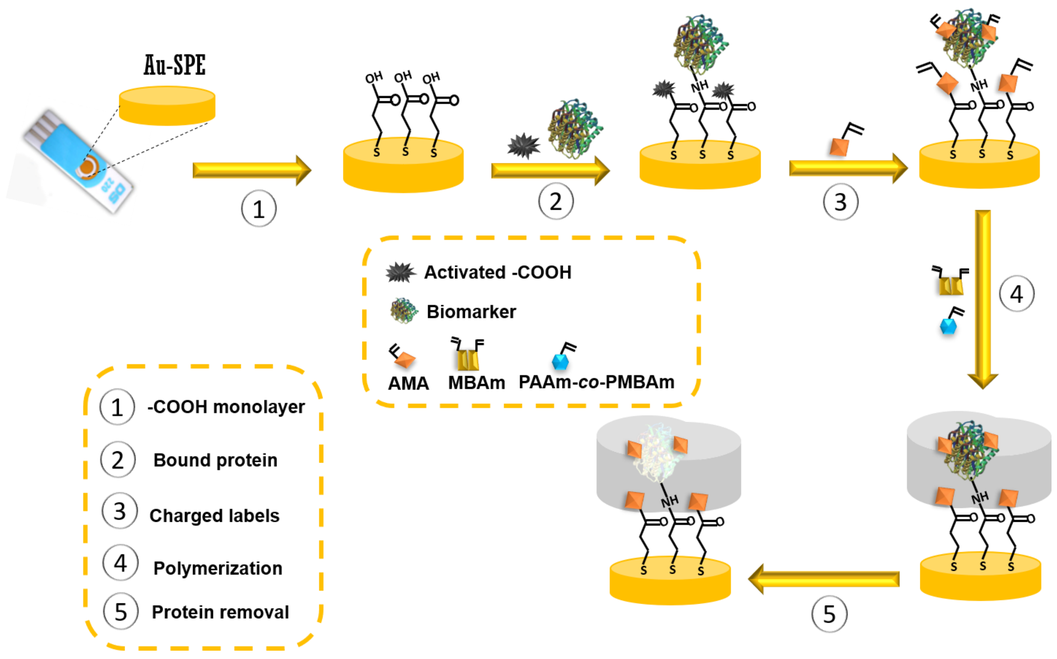
Methodology

Synthesis of tailor-made block copolymer



Synthesis route to the PAAm-*co*-PMBAm block copolymer.

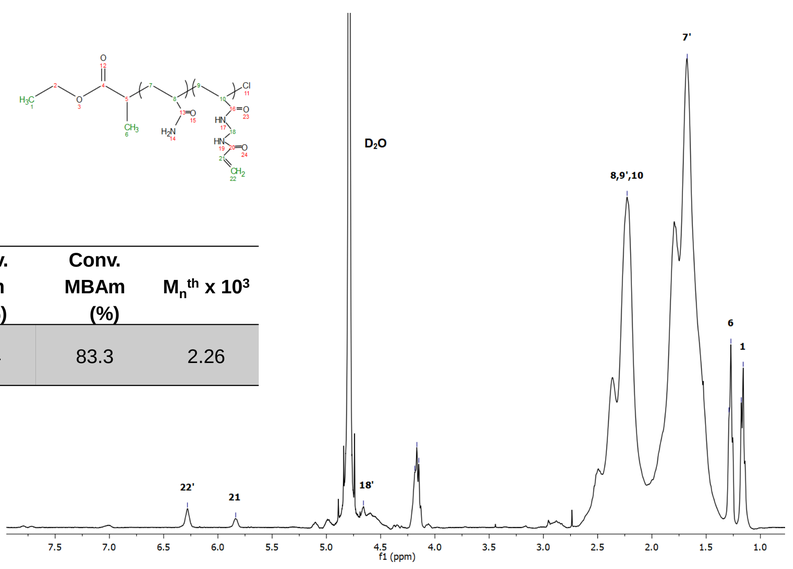
Immobilization of the block copolymer and MIP assembly



Schematic Illustration of the different steps related to the biosensor device.

Results

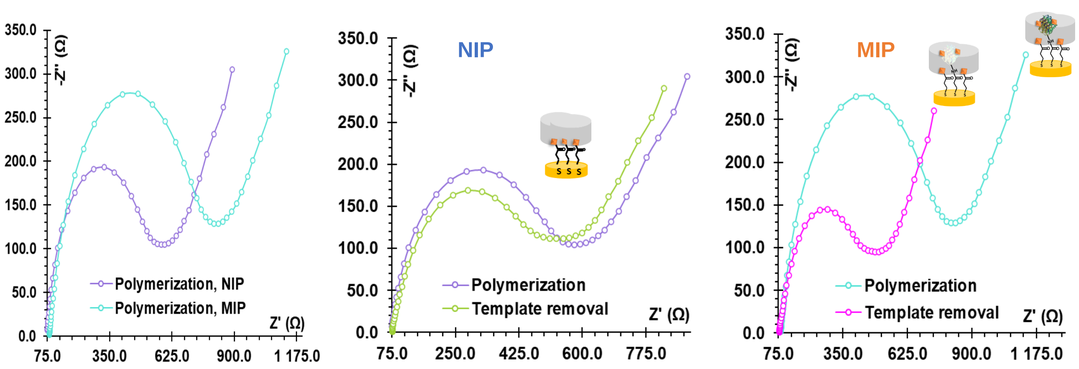
Characterization of PAAm-co-PMBAm



Code	Conv. AAm (%)	Conv. MBAm (%)	M_n^{th} x 10^3
DSO9	81.4	83.3	2.26

^{1}H NMR spectrum (400 MHz), in D_2O, of purified PAAm-co-PMBAm.

Electrochemical analysis



NIP vs. MIP

Template Removal

General considerations

It is expected that this plan may allow producing MIP-based biosensors of improved selectivity and sensitivity features. Moreover, the innovative approach proposed in this work could inspire other researchers to prepare MIP structures with a higher level of control, a pivotal feature for the device performance.

Acknowledgment

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