New modified electrochemical conductive paper support for BSA detection

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Chemical sensors and biosensors are widely used to detect various kinds of protein target biomolecules. Molecularly Imprinted Polymers (MIPs) have raised great interest in this area, because these act as antibody-like recognition materials, with high affinity to the template molecule. Compared to natural antibodies, these are also of lower cost and higher stability.

There are different types of supports used to carry MIP materials, mostly of these made of gold, favourably assembled on a Screen Printed Electrode (SPE) strategy. For this work a new kind of support for the sensing layer was developed: conductive paper. This support was made by modifying first cellulose paper with paraffin wax (to make it waterproof), and casting a carbon-ink on it afterwards, to turn it conductive.

The SPAM approach previously reported in[1] was employed herein to assemble to MIP sensing material on the conductive paper. The selected charged monomers were (vinylbenzyl) trimethlammonium chloride (positive charge) or vinylbenzoic acid (negative charge), used to generate binding positions with single-type charge (positive or negative). The non-specific binding area of the MIP layer was assembled by chronoamperometry-assisted polymerization (at 1 V, for 60, 120 or 180 seconds) of vinylbenzoate, cross-linked with ethylene glycol vinyl ether. The BSA biomolecules lying within the polymeric matrix were removed by Proteinase K action. All preparation stages of the MIP assembly were followed by FTIR, Raman spectroscopy and, electrochemical analysis.

In general, the best results were obtained for longer polymerization times and positively charged binding sites (which was consistent with a negatively-charged protein under physiological pH, as BSA). Linear responses against BSA concentration ranged from 0.005 to 100 mg/mL, in PBS buffer standard solutions. The sensor was further calibrated in standard solutions that were prepared in synthetic or real urine, and the analytical response became more sensitive and stable. Compared to the literature, the detection capability of the developed device is better than most of the reported electrodes.

Overall, the simplicity, low cost and good analytical performance of the BSA SPE device, prepared with positively charged binding positions, seems a suitable approach for practical application in clinical context. Further studies with real samples are required, as well as gathering with electronic-supporting devices to allow on-site readings.

[1] FTC Moreira, S Sharma, RAF Dutra, JPC Noronha, AEG Cass, MGF Sales, *Biosens Bioelectron*, **2013**, 15, 237-244.

Acknowledgements: The authors acknowledge the financial support of European Research Council though the Starting Grant, ERC-StG-3P's/2012, GA 311086 (to MGF Sales).