O3 SB4

AMPEROMETRIC BIOSENSOR BASED ON LACCASE PHYSICALLY ENTRAPPED ON A POLYTHIOPHENE–MODIFIED SCREEN PRINTED ELECTRODE FOR RAPID DETECTION OF TOTAL POLYPHENOL CONTENT IN FOOD MATRIX

L. Ciogli, S. D'Onofrio, C. Tortolini, F. Mazzei, G. Favero

Dipartimento di Chimica e Tecnologie del Farmaco, Sapienza Università di Roma, Roma, Italy

The communication between enzymes and electrode surfaces is of fundamental importance in biosensor development.
Conductive polymers, such as polyaniline, polypyrrole and polythiophene have been very often employed as electrode modifier to allow an efficient enzyme wiring. Their (semi)conductive properties, biocompatibility and versatility, have made these materials very interesting in this field since their discovery in the late 1980s. Furthermore, the electrochemical polymerization allows a direct deposition on the electrode surface and it is much faster than a time and reagents-consuming chemical synthesis.
Despite these features, polythiophene application in biosensing has only partly been seen until now. It has been used mainly in molecularly imprinted polymers, in supercapacitors and for enzyme immobilization. One of the problems that can affect the enzyme interacting with this kind of polymer is the need to use organic solvents to solubilize the monomers and to reach the high potentials requested for the monomer oxidation in electrosynthesis [1]. Further, during the polymerization, the upcoming polythiophene structure can be damaged by the high potential applied (polythiophene paradox).

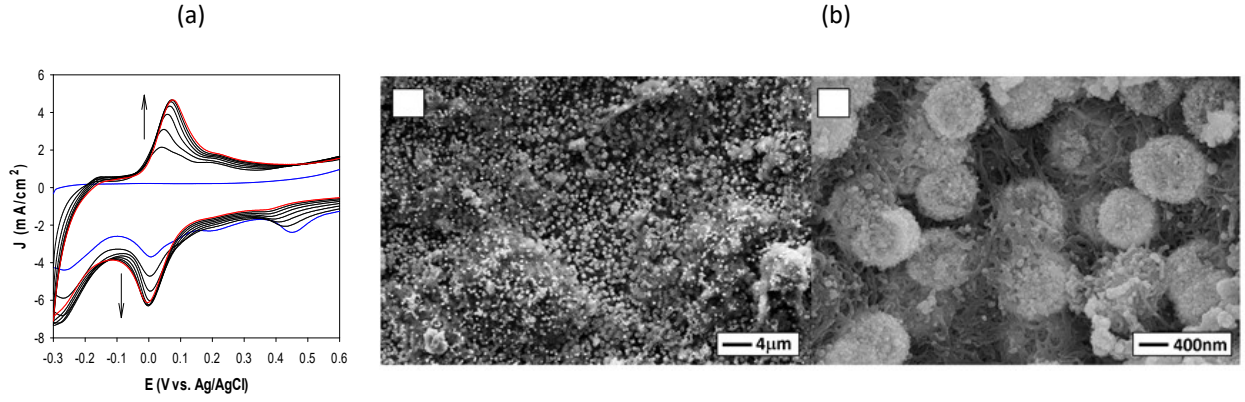

Figure 1. (a) Cyclic voltammetry for electropolymerization of 3-metoxy-thiophene in aqueous solution, (b) SEM images of electropolymerized electrodic surface at different magnifications.

The aim of this work was the evaluation of an innovative immobilization method based on electrosynthetized polythiophene for the development of biosensor. The method has been tested with laccase in order to evaluate the possibility to use polythiophene as

immobilization matrix, preventing enzymatic denaturation phenomena which would affect the biosensor performance in terms of sensitivity, linear range, and stability. To this end, the biosensor proposed herein has been prepared in mild conditions by using a graphite SPE electrode, modified by electropolymerization in an aqueous solution of 3-methoxythiophene (Figure 1(a)) in the presence of laccase performing cyclic voltammetry in drop mode [2]. The polymer film was characterized by scanning electron microscopy (Figure 1(b)) and impedance spectroscopy. The calibration plot of the biosensor showed a linear response in the concentration range from 7 to 110 µM expressed as catechol, with a limit of detection of 2.5 µM. The method exhibited good selectivity, stability and reproducibility for detecting polyphenols in foodstuffs.

References

[1] Fusco G., Göbel G., Zanoni R., Kornejew E., Favero G., Mazzei F., Lisdat F., Electrochimica Acta, 2017, 248, 64.
[2] Fusco G., Göbel G., Zanoni R., Bracciale M.P., Favero G., Mazzei F., Lisdat F., Biosensors and Bioelectronics, 2018, 112, 8.