WORKSHOP BIOSENSORS ESSAOUIRA 2013

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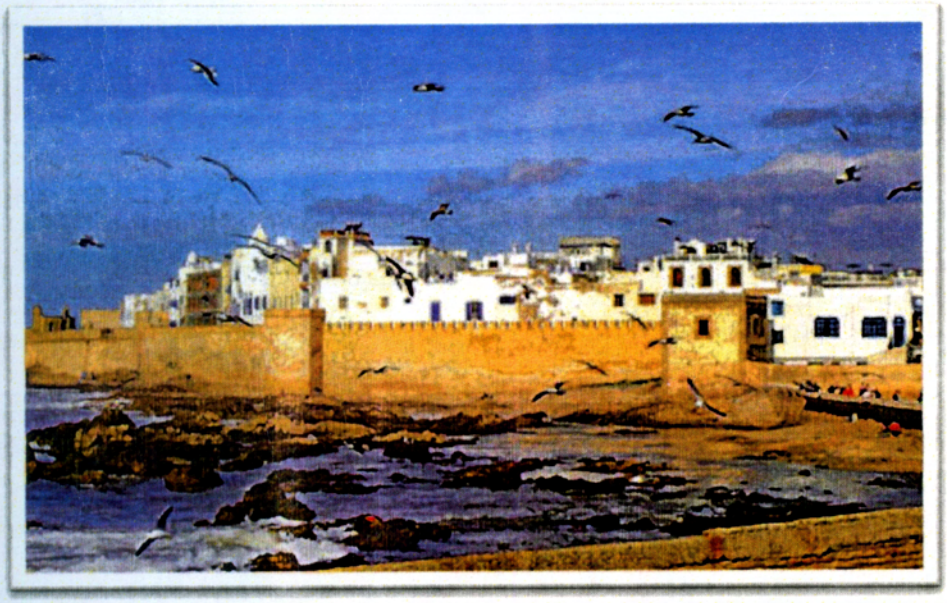
ON

"BIOSENSORS FOR FOOD SAFETY AND ENVIRONMENTAL MONITORING"



BOOK OF ABSTRACTS

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NANOSIZED MEDIATORS ON MACROCYCLIC CARRIERS AS A PLATFORM FOR ELECTROCHEMICAL ENZYME AND DNA SENSORS

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Abstract

There is an urgent need in the development of sensitive and inexpensive biosensors for medical diagnostics, pharmaceutics and potential hazards assessment. Many of the operational and analytical characteristics of the biosensors depend on rational design of a transducer applied for the immobilization of biosensing elements and signal transduction. In this report, new approaches to the assembling of biosensing layers of electrochemical sensors based on native DNA, aptamers and cholinesterase on the platform of macrocyclic ligands bearing both mediators and biomolecules are presented.

Multifunctional thiacalix[4]arenes with the substituents at the lower rim bearing electrochemically active groups were synthesized and introduced together with biorecognition elements in voltammetric, impedimetric and potentiometric biosensors. Two signal transduction principles were realized, i.e., (i) the detection of the electron exchange in the surface layer affected by a target interaction due to the changes in flexibility of the macrocyclic ligands and accessibility of their redox centers, and (ii) the formation of metal nanoparticles by their chemical deposition within the macrocyclic matrices bearing catechol fragments.

The concept of electron exchange monitoring was examined by detection of thrombin and ochratoxin A with specific DNA aptasensors immobilized together with macrocycles bearing phenazine dyes (thionine, neutral red). Binding with thrombin and ochratoxin A resulted in decrease of the peak current related to redox label or increase of the stationary potential and resistance of the charge transfer. The detection limits down to 0.3 nM were achieved with minimal influence of non-specific protein adsorption for thrombin. In a similar manner, ochratoxin A was detected within nanomolar range of concentration. Spiked samples of beer were tested with recovery of about 70%.

Silver nanoparticles decorated with macrocyclic ligands bearing catechol fragments were applied for detection of acetylcholinesterase inhibitors. High affinity of Ag toward thiocholine, a product of the substrate hydrolysis, made it possible to decrease the working potential and improve the sensitivity of pesticide detection up to 0.1 nM. The biosensor developed is compatible with the protocols of thionic pesticide oxidation required for their sensitive determination. Paraoxon, malaoxon, aldicarb and carbaryl were determined in model solutions and spiked juices.

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