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Abstract

Label-free Capacitive Biosensors

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Abstract:
Examinations of charge storage in man-made molecular junctions underpin not only fundamental developments in our understanding of capacitive phenomena but also allows us to design label-free capacitive biosensors. In the present work the principles of operation of electrochemical capacitive sensors is performed and applications of these capacitive interfaces as capacitive assays are demonstrated and exemplified through the generation of redox molecular films comprising antibody receptors. The molecular assaying protocol reported herein is based on the use of redox-tagged sensing interfaces. This technique provides guidance for the fabrication of high-sensitivity capacitive interfaces with special attention to their molecular design. Interfaces designed in this way have important applications to molecular diagnostics. As the method is both label-free and reagentless, it is conducive to point-of-care usage and can be quite flexible for the detection of a multitude of protein species. This method has already been utilized for the detection of a range of protein biomarkers, including: C-reactive protein (CRP)1-6, -synuclein antibody (Ab-Syn)4, non-structural protein 1 (NS1)7, 8, prostatic acid phosphatase (PAP), immunoglobulin G (IgG), aflatoxin M1 (AFM1), and interleukin-6 (IL-6).

We report about the principles of the method by introducing the physical concepts behind the transducer signals which can be relevant to researchers interested in the development or in using capacitive analytical methods of quantification though the designing of interfaces containing electrochemical capacitance signal. Capacitive approaches present advantages among other analytical strategies such as:) It allows the detection, even at low concentrations, in a label-free and point-of-care format;) Under optimal conditions, in terms of frequency range and electrochemical potential of operation of the sensing interface, the signal measurement can be performed in just 5 min or even lower times;) The absence of redox probe in solution makes the method simpler. The crucial aspect of the assaying is the control and the know-how associated with the fabrication of the sensing interface. The know-how is crucial in order to obtain an optimal response of the analytical assay as we will be reported in the step- by-step presentation of the protocol.

Biography:
Professor Paulo R. Bueno has authored more than 170 papers, holds six licensed patents, and is one of the founders of Osler Diagnostics in the U.K. Some of his research projects have received awards from the Royal Society (including the Brian Mercer Feasibility and Newton Advanced Fellowship awards). He was endorsed as an exceptional talent in Physical Chemistry by the Royal Society. He is Fellow of Royal Society of Chemistry, and an invited member of the American Chemical Society. Dr. Bueno is also a member of other scientific societies, among them the Electrochemical Society and the International Society of Electrochemistry.

Recent Publications:

1. F. C. B. Fernandes, M. S. Góes, J. J. Davis and P. R. Bueno, Biosensors and Bioelectronics, 2013, 50, 437-440.
2. A. Santos, J. P. Piccoli, N. a. Santos-Filho, E. M. Cilli and P. R. Bueno, Biosensors and Bioelectronics, 2015, 68, 281-287.
3. F. C. B. Fernandes, A. Santos, D. C. Martins, M. S. Góes and P. R. Bueno, Biosensors and Bioelectronics, 2014, 57, 96-102.
4. F. C. B. Fernandes, A. V. Patil, P. R. Bueno and J. J. Davis, Analytical Chemistry, 2015, 87, 12137-12144.
5. J. Lehr, F. C. B. Fernandes, P. R. Bueno and J. J. Davis, Analytical Chemistry, 2014, 86, 2559-2564.

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