BioPoC: A Novel Biosensing Technology Based on Responsive Polymers and a Low-Cost Transducing Technology for Point-of-Care Applications

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Abstract

Medical diagnostics sector is relying on affordable, hand-held autonomous devices incorporating smart integrated biosensing interfaces that enable clinical analysis with minimal technical expertise, end-user intervention and resource requirements. Crucially, the development of simple yet reliable transducing technologies affording true advantages over well-established electrochemical, potentiometric, or optical detectors in the analysis of non-treated complex biological matrices is expected not only to provide convenient solutions to the most contemporary demands in decentralized health-care systems but also to facilitate the translation of global health-care strategies into practice.
In this response, our group has developed a novel enzyme-based biosensing technology, we call it “BioPoC”, for the determination of biomarkers in undiluted urine. “BioPoC” biosensing technology is demonstrated by using pH responsive free-standing membranes or pH responsive polymer coated paper-based biosensing surfaces for the determination of urinary urea and creatinine. The biosensing surfaces, after their modification with urease or creatinine deiminase, respectively are sandwiched between patterned conductive strips and spacers, thus creating an inbuilt dosing well and a vertical microfluidic channel. “BioPoC” biosensing technology relies on the measurement of the time required the original electric resistance between the conductive strips (R_{∞}) to become finite (R_{finite}) because of the specific, enzyme substrate-triggered degradation of the polymer and the ensuing vertical flow of the sample, which thus allows an ionic type electrical bridging between the conductive strips [1]. Based on a smart assembly with three conductive strips onto a SIM card, and through a wireless communication with a Bluetooth microprocessor-controlled time and electric resistance measuring circuits, the device manages an automatic on/off (addition of the sample/end of the measurement) function for measuring the polymer degradation time via electric resistance measurements between the conductive strips, calculations, and the display of the results [2]. The different version of the “BioPoC” devices were successfully applied to the determination of urinary urea and creatinine.

References

[1] Eleni I. Tzianni, Jan Hrbac, Dimitrios K. Christodoulou, Mamas I. Prodromidis*, Sensors & Actuators: B. Chemical 304 (2020) 127356.

[2] Eleni I. Tzianni, Ioannis Moutsios, Dimitrios Moschovas, Apostolos Avgeropoulos, Konstantinos Govaris, Lazaros Panagiotidis, Mamas I. Prodromidis*, Biosensors and Bioelectronics 207 (2022) 114204.

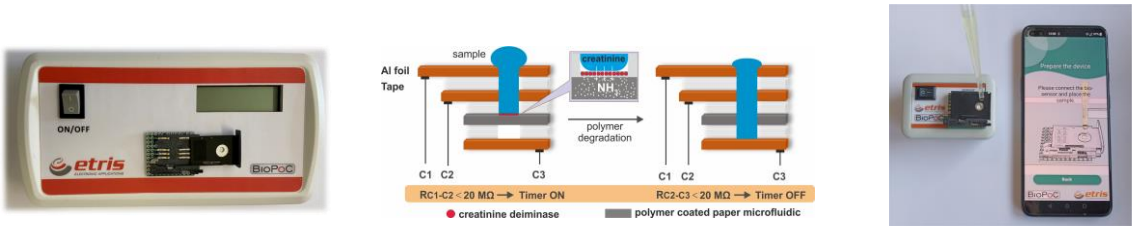

Figure 1: “BioPoC” devices. (Left) Standalone device. (Middle) Simplified representation of the biosensor buildup. (Right) Smartphone paired SIM card-type integrated device.