Paper Title

Fast Prototyping of Precise, Flexible, Multiplexed, Printed Electrochemical Enzyme-Linked Immunosorbent Assay Device for Point-of-Care Biomarker Quantification

Abstract

Point-of-care (POC) diagnostic devices based on lab-on-a-chip (LOC) technology have the potential to revolutionize medical diagnostics. However, the development of an ideal microfluidic system based on LOC technology for diagnostics purposes requires overcoming several obstacles, such as improving sensitivity, selectivity, portability, cost-effectiveness, and prototyping methods. While numerous studies have introduced technologies and systems that advance these criteria, existing systems still have limitations. Electrochemical enzyme-linked immunosorbent assay (e-ELISA) in a LOC device offers numerous advantages, including enhanced sensitivity, decreased turnaround time, minimized sample and analyte consumption, reduced cost, disposability, and suitability for miniaturization, integration, and multiplexing. In this study, we present a novel design and fabrication method for a microfluidic diagnostic platform that integrates screen-printed electrochemical carbon/silver chloride electrodes on flexible printed circuit boards with flexible, multilayer, polydimethylsiloxane (PDMS) microfluidic networks to accurately manipulate and pre-immobilize analytes for performing electrochemical enzyme-linked immunosorbent assay (e-ELISA) for multiplexed quantification of blood serum biomarkers. We further demonstrate fast, cost-effective prototyping, as well as accurate and reliable detection performance of this device for quantification of interleukin-6-spiked samples through electrochemical analytics methods. We anticipate that our invention represents a significant step towards the development of user-friendly, portable, medical-grade, POC diagnostic devices.

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Keywords:

Lab-on-a-chip, Point-of-care diagnostics, Electrochemical ELISA, Biomarker quantification, Fast prototyping