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Data Article

Data on a new sensitivity-improved miniaturized label-free electrochemical biosensor

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ABSTRACT

This article presents a new sensitivity-improved electrochemical measurement architecture for cardiovascular disease (CVD) diagnosis by detecting CVD biomarkers, S100 beta protein and C-reactive protein (CRP). The new architecture includes a design for a new electrochemical measurement set-up, which improves the reaction conditions of chemical and biological molecules and incorporates a newly biochip design. With the new architecture, electrochemical measurement experiments were undertaken. The results obtained are related to the research article entitled "Improving sensitivity of a miniaturized label-free electrochemical biosensor using zigzag electrodes" [1].

Specifications Table

Subject area	Biosensors
More specific subject area	Electrochemistry

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Type of data	Graphs, figures, tables, text files
How data was acquired	Electrochemical analyzer (CHI614D, CH Instrument), Biacore T200 (GE Healthcare)
Data format	Raw
Experimental factors	The proteins at different concentrations were captured by the antibodies based on a 4-ATP or cysteamine modified sensing surface.
Experimental features	1. Development of the process for antibody-antigen interactions. 2. Detection of two kinds of CVD biomarkers, S100 beta proteins and C-reactive proteins, taken as electrochemical impedance measurements.
Data source location	National Taiwan University in Taipei, Taiwan
Data accessibility	Data is with this article
Related research article	Y.-C. Kuo, et al., "Improving sensitivity of a miniaturized label-free electrochemical biosensor using zigzag electrodes," Biosensors and Bioelectronics, 2018.

Value of the data

- The data article provides the design concept of an electrochemical measurement set-up.
- The flow rate and the reaction time of the chemical/biological molecules can offer improvement for a more effective sensing surface.
- The electrochemical measurement sensitivity can be improved by adopting an interdigitate-zigzag biochip.
- Two kinds of CVD biomarkers, S100 beta proteins and CRP, can be detected not only on an ATP-based surface but also on a cysteamine-based surface.

1. Data

This article is related to the research article entitled “Improving sensitivity of a miniaturized label-free electrochemical biosensor using zigzag electrodes” [1]. This article presents an improved electrochemical impedance measurement system for cardiovascular disease (CVD) diagnosis by detecting CVD biomarkers, S100 beta proteins and C-reactive proteins (CRP) [2]. Fig. 1 shows the electrochemical impedance data in the Nyquist form for detecting S100 beta protein and CRP. In the new measurement system, three kinds of biochips (e.g. interdigitate biochip, interdigitate-semicircle biochip, and interdigitate-zigzag biochip) were used based on 4-ATP and cysteamine modified architectures.

2. Experimental design, materials, and methods

2.1. Microfluidic system for electrochemical measurement [3]

Silicone thin film of 300 μm thickness was used to fabricate the microchannel due to its characteristic properties such as elasticity, malleability, sealability, hydrophobicity, and inactiveness in chemicals. First, the silicone thin film was covered on the biochip. The hollowed area of the silicone thin film formed a closed volume around the electrodes of the biochip as a detection area (see Fig. 2 (a)). The cover of the measurement device with an inlet and an outlet was then pressed onto the silicone thin film around detection area by screwing the cover and bottom of measurement device together to let the solutions flow through the microchannel without oozing into the solutions (Fig. 2 (b)). Due to the pressing process, the thickness was changed from 300 μm to 100 μm, and a microchannel with a 100 μm height was formed. The closed volume of the microchannel was about