An Electrochemical CMOS Biosensor Array For Point-Of-Care Applications

Tech ID: 30086 / UC Case 2018-199-0

BACKGROUND

Point-of-care (POC) testing is essential to halt the spread of deadly infectious diseases (e.g., Ebola, Zika, etc.) and is needed for rapid and accurate screening both in and outside of clinical settings. Label-free bioassays are desirable for POC testing as they have fewer reagents and assay steps resulting in lower cost and ease of use.

Biosensors based on electrochemical impedance spectroscopy (EIS), an ultra-sensitive, label-free sensing technique, are a promising technology for precise and rapid disease diagnosis at the point-of-care. However, EIS usually requires mixers and lock-in detection to measure both the magnitude and phase of the complex impedance.

TECHNOLOGY DESCRIPTION

Researchers from UC San Diego have developed a novel field deployable 16×20 biosensor array for highly scalable label-free point-of-care applications, such as nucleic acid testing. The on-chip sensors use a streamlined and highly scalable polar modulation method to monitor bioassay events.

Using the polar-mode measurement technique, label-free detection of DNA hybridization was measured with the designed array demonstrating promise for precise and highly scalable biosensing in POC applications. Hsu *et al* (2018) demonstrated the use of this invention to measure hybridization of Zika virus oligonucleotides.

APPLICATIONS

In-pixel circuitry (140×140 μm^2) provides for the measurement of the necessary phase changes of the on-chip sensors using a trans-impedance amplifier, zero-crossing detector, and a first-order noise-shaping time-to-digital converter without the need for quadrature signal analysis.

Implemented in a 0.18 µm process, the 3×4 mm2 chip achieves state-of-the-art performance with an rms phase error of 0.04% at 50 kHz. This work provides full integration of in-pixel electrode and meausurement circuitry for precise and highly scalable biosensing in Point-of-care applications

ADVANTAGES

The unique architecture enables in-pixel digitization and accumulation, which increases the SNR by 10 dB for each 10× increase in readout time

STATE OF DEVELOPMENT

Measured electric and biological data from silicon

INTELLECTUAL PROPERTY INFO

This technology is patent pending and available for licensing and/or research sponsorship.

RELATED MATERIALS

- Chung-Lun Hsu, Alexander Sun, Yunting Zhao, Eliah Aronoff-Spencer and Drew A. Hall. A 16×20 Electrochemical CMOS Biosensor Array with In-Pixel Averaging Using Polar Modulation. Custom Integrated Circuits Conference (CICC), 2018. DOI:10.1109/CICC.2018.8357044 - 04/08/2018

PATENT STATUS

Country	Type	Number	Dated	Case
Patent Cooperation Treaty	Published Application	2019/169192	09/06/2019	2018-199

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OTHER INFORMATION

KEYWORDS

point-of-care (POC); electrochemical impedance spectroscopy (EIS); biosensor array; phase-to-digital converter, analyte, nucleic acid

CATEGORIZED AS

- **Communications**
  - Wireless
- **Medical**
  - Devices
- **Sensors & Instrumentation**
  - Biosensors
- **Engineering**
  - Other

RELATED CASES

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