A 3D Microfluidic Actuation and Sensing Wearable Technology for In-Situ Biofluid Processing and Analysis

Tech ID: 29846 / UC Case 2018-678-0

SUMMARY

UCLA researchers in the Department of Electrical and Computer Engineering have developed a novel wearable biosensor capable of measuring biomarkers in real time through biofluids like sweat.

BACKGROUND

There is a current revolution in wearable technology to track health status in real time. In the advent of Apple watches and Fitbit, health tracking has become a hot trend that many consumers are adopting. Currently, commercialized non-invasive sensors are only capable of tracking physical activity and vital signs. However, recent advances in electrochemical sensor development has opened the opportunity to measure biofluids that are rich in biomarkers for health status. Examples of biosensors that utilize biofluids have been able to track calorimetric and electrochemical analytes but are limited in storage capacity. To realize a fully autonomous lab-on-the-body platforms with diverse operations, fundamentally, in-situ biofluid actuation and compartmentalization methodologies must be employed in conjunction with the demonstrated sensing capabilities.

In the growing field of wearable biosensors, there is a need for real time sensing of biomarkers in biofluid. However, this calls for the innovation of microfluidic technology to: utilize periodic and continuous mixing systems to segregate previous analytes, in-situ samples processing and purification for real time analysis, and the use of advanced assays to utilize micro volumes for analysis. As of yet, there exists no technology that integrates all of these features in a wearable biosensor.

INNOVATION

Dr. Emaminejad at UCLA has developed a microfluidic wearable biosensor that utilizes a suite of programmable electro-fluidic interfaces, capable of capitalizing on the pitfalls of current technology. Briefly, the device is capable of pumping, mixing and valving for wearable sample analysis. The device has been shown to measure the flux in glucose in iontophoretically-stimulated sweat after glucose intake in fasting subjects. Such results highlight the promising potential that the device has to perform complex sample processing and analysis operations, showing promise for a fully autonomous lab-on-the-body platform for a broad range of healthcare applications.

APPLICATIONS

- Measurement of colorimetric uptake in individuals in real time
- Measurement of glucose levels in diabetics in real time (as well as healthy subjects)
- Potential measurement of other biomarkers in sweat

ADVANTAGES

- Only microfluidic wearable biosensor capable of real-time biofluid analysis
- Compartmentalization of biofluids for multiple end point analyses
- In-situ processing of biofluids for enhanced selectivity and detection of metabolites/biomarkers
- Use of pre-existing technology (Bluetooth); Integration of common tech

STATE OF DEVELOPMENT

The device has been demonstrated to measure blood glucose concentrations in sweat.

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INVENTORS

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OTHER INFORMATION

KEYWORDS

Microfluidics, Biosensor, Biofluid, Wearable Technology, Wireless Communication, Bluetooth, Sweat, Biomarkers, Calorimeter, Nanomaterials, real-time monitoring, calcium monitoring, pH monitoring, glucose monitoring

CATEGORIZED AS

- **Biotechnology**
  - Health
- **Communications**
  - Wireless
- **Engineering**
  - Engineering
- **Materials & Chemicals**
  - Nanomaterials
- **Medical**
  - Devices
  - Diagnostics
- **Nanotechnology**
  - NanoBio
- **Sensors & Instrumentation**
  - Biosensors
  - Medical
  - Physical Measurement

RELATED MATERIALS

- H. Y. Y. Nyein, W. Gao, Z. Shahpar, S. Emaminejad, S. Challa, K. Chen, H. M. Fahad, L.-C. Tai, H. Ota, R. W. Davis, and A. Javey, A Wearable Electrochemical Platform for Noninvasive Simultaneous Monitoring of Ca2+ and pH, in ACS Nano, 2016.

RELATED CASES

2018-678-0

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Published Application	20210022651	01/28/2021	2018-678

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Wearable Voltammetric Monitoring of Electroactive Drugs
- Mediator-Free Electroenzymatic Sensing with Enhanced Sensitivity and Selectivity for Wearable Metabolite and Nutrient Monitoring Applications
- A Wearable Freestanding Electrochemical Sensing System
- Multiplexed Sweat Extraction And Sensing Wearable Interface For Normalized And Periodic Analysis
- A Wearable Platform for In-Situ Analysis of Hormones
- Ultra-Low Cost, Transferrable and Thermally Stable Sensor Array Patterned on Conductive Substrate for Biofluid Analysis
- In-Situ Sweat Rate Monitoring For Normalization Of Sweat Analyte Concentrations

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