Wearable Voltammetric Monitoring of Electroactive Drugs

Tech ID: 31843 / UC Case 2020-393-0

SUMMARY

UCLA researchers in the Department of Electrical and Computer Engineering have developed a voltammetric wearable device capable of monitoring electroactive drug circulation and abundance in biofluids. This non-invasive monitoring system can be used for electroactive drug therapy management, drug compliance/abuse monitoring, drug-drug interaction studies, and personalized dosing.

BACKGROUND

Exogenous molecules, such as drugs, remain underexplored despite studies showing circulating drugs to be partitioning in sweat more than in blood. Wearable drug monitoring devices targeting epidermally-retrievable biofluids, such as sweat, can improve drug compliance/abuse monitoring and personalize therapeutic drug dosing. Voltammetry-based approaches eliminate the reliance of the availability of recognition elements because they uniquely leverage the electroactive nature of target drug molecules. For quantification however, a sensitive voltammetric sensing interface (with high signal-to-background ratio and decoupling of the confounding effect of endogenous electroactive species and baseline variation) is needed and wireless voltammetric excitation and signal acquisition/transmission is necessary.

INNOVATION

UCLA researchers have developed a wearable drug monitoring system for monitoring electroactive drugs in epidermally-retrievable biofluids. The device has been successfully prototyped and used to quantify three model drugs, with nano- to sub/low-micromolar detection of the drugs using anodic-treated BDDE. The interference of five endogenous electroactive species (including uric acid and amino acids) were also investigated, resulting in an undistorted potential window within which the oxidation of target drugs can be captured sensitively and selectively. This methodology was used to establish a design space and optimize operational settings to develop a coupled sensing system and analytical framework to render sample-to-answer drug analysis.

APPLICATIONS

- Drug monitoring
- Drug pharmacokinetics tracking

ADVANTAGES

- Non-invasive
- Fast
- Accurate
- Sensitive—high signal-to-noise ratio
- Broad range of substrates/drugs

STATE OF DEVELOPMENT

The wearable device prototype has been tested and optimized for minimal background signal from endogenous electroactive species present in a biofluid matrix. Three model drugs have been successfully tested and detected at nano- to sub/low-micromolar levels using the anodic-treated BDDE in vitro(sweat samples).

RELATED MATERIALS

- Lin, S. et al. "A Design Framework and Sensing System for Non-invasive Wearable Electroactive Drug Monitoring", ACS Sensors, 2020.

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INVENTORS

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OTHER INFORMATION

KEYWORDS

electroactive drug, monitoring, pharmacokinetic tracking, wearable device, voltammetric, voltammetry, sweat samples, drug monitoring

CATEGORIZED AS

- **Biotechnology**
  - Health
- **Medical**
  - Devices
  - Other
  - Software

RELATED CASES

2020-393-0

▶ Emaminejad, Sam, et al. "Autonomous sweat extraction and analysis applied to cystic fibrosis and glucose monitoring using a fully integrated wearable platform." Proceedings of the National Academy of Sciences, 2017 114.18, 4625-4630.

PATENT STATUS

Country	Type	Number	Dated	Case
Patent Cooperation Treaty	Reference for National Filings	2021/081502	04/29/2021	2020-393

Patent Pending

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

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