Electronic Detection Of Molecular Targets, Including Proteins, Oligonucleotides And Other Small Molecules

Tech ID: 10304 / UC Case 2006-211-0

BACKGROUND

While many assays exist for the detection of DNA, RNA, proteins and other molecular targets, most sensors require sample purity and rigorous controls available only under ideal laboratory settings. These constraints significantly dampen the effectiveness of most reported sensing technologies for real world applications. Rapid, accurate and cost-effective sensors that can quickly identify and quantify targets within contaminated samples would provide a critical tool for diagnostics, forensics, food safety, water/soil testing, civil defense, and other applications.

DESCRIPTION

Researchers at the University of California, Santa Barbara have developed an electronic (electrochemical) platform for the detection of molecular targets (including, but not limited to DNA, RNA, proteins and small molecules) that appears suitable for applications even in complex, contaminant-ridden samples such as blood serum, saliva, urine, soil and foodstuffs. The approach is rapid (providing results within seconds to minutes), fully electronic and, in some implementations, reagentless and reusable (potentially requiring only simple, room temperature aqueous washes for regeneration).

In laboratory testing of the prototypes, the researchers have achieved femtomolar sensitivity for the detection of DNA, which appears to be at least two orders of magnitude better sensitivity than any other reported, label-free electronic DNA sensors. Tests with proteinaceous targets demonstrate detection limits as low as 50 pM (measured directly in blood serum) and excellent specificity, and with small molecules and ions the technology achieves micromolar and parts-per-billion detection limits respectively in the presence of soil and other complex contaminants. The sensitivity allows for the detection of oligonucleotides and proteins indicative of pathogens or disease states, and small molecules and ions that might be of medical, industrial or environmental concern. Experiments with earlier generations also suggest that, after the test is performed, the same device can test another sample with almost no degradation in sensitivity or accuracy after a simple wash with aqueous solutions (distilled water, guanidine hydrochloride solutions, detergent solutions). The device is capable of being designed with multiple assays to allow one device to accurately detect the presence and level of many different targets simultaneously and with one sample. And, being fully electronic, the approach is readily adaptable to hand-held, field-portable electronic devices.

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OTHER INFORMATION

KEYWORDS

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CATEGORIZED AS

- **Biotechnology**
  - Other
- **Environment**
  - Other
- **Medical**
  - Devices
  - Diagnostics
- **Security and Defense**
  - Other
- **Sensors & Instrumentation**
  - Biosensors

RELATED CASES

2006-211-0

SUGGESTED USES

- Medical diagnostics
- Civil Defense
- Environmental Monitoring (Food/Water Safety)
- Forensics
- Authentication

"Single-step electronic detection of femtomolar DNA by target-induced strand displacement in an electrode-bound duplex" Yi Xiao, Arica A. Lubin, Brian R. Baker, Kevin W. Plaxco, and Alan J. Heeger, PNAS - October 2006

"A Reagentless Signal-On Architecture for Electronic, Aptamer-Based Sensors via Target-Induced Strand Displacement" Yi Xiao, Brian D. Piorek, Kevin W. Plaxco, and Alan J. Heeger, JACS COMMUNICATIONS - 2005

"Electrochemical Detection of Parts-Per-Billion Lead via an Electrode-Bound DNAzyme Assembly" Yi Xiao, Aaron A. Rowe, and Kevin W. Plaxco, JACS COMMUNICATIONS - December 2006

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	7,803,542	09/28/2010	2006-211

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Drift-Free and Calibration-Free Measurement of Analytes
- Drift-Free, Self-Calibrated Interrogation Method For Electrochemical Sensors Based On Electron Transfer Kinetics
- Electronic Detection Of Molecular Targets, Including Proteins, Oligonucleotides And Other Small Molecules
- Fluorescent and Electrochemical DNA-Based Switches for Antibody Detection
- Dual-Labeled E-AB Platform for Continuous, Real-Time Monitoring of Small Molecules

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