(SD2017-342) IMPLANTABLE BIOSENSOR (Injectable Biomote Biosensor Patent No. 12,004,855)

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ABSTRACT

An implantable biosensor may be placed subcutaneously to monitor the concentration of an analyte in a body fluid. The biosensor may include an electrochemical cell and an antenna. The components of the biosensor, including the electrochemical cell and the antenna, may be disposed on a same substrate. The electrochemical cell may include multiple electrodes for performing electrochemical measurements that include a first measurement of the analyte concentration in the body fluid, a second measurement of a background interference present in the body fluid, and a third measurement of a pH level within the body fluid. The antenna may receive, from a transceiver, radio frequency (RF) waves for wirelessly powering the implantable biosensor. The antenna may further transmit, back to the transceiver, a backscatter signal encoding a result of the electrochemical measurements.

TECHNOLOGY DESCRIPTION

Researchers from UC San Diego have invented and patented (U.S.Patent No. 12,004,855) a wireless, fully-integrated, miniature “BioMote” microelectrode electrochemical sensor array that can be injected through a 16-gauge syringe for continuous, for long-term monitoring of analytes.

The low-power multi-technique potentiostat supports both amperometric and potentiometric techniques achieving 2.5 nA sensitivity with 30.1 dB dynamic range and 0.5 mV sensitivity with 43 dB dynamic range, respectively. The measurements are transmitted to a wearable device through backscatter using a self-oscillating current-to-frequency (I-to-F) converter. The system is wirelessly powered via the coupling between an on-chip 4-turn coil and a wearable device at 985 MHz. The self-contained 0.85×1.5 mm2 chip is implemented in 65 nm CMOS and consumes 970 nW.

APPLICATIONS

One example would be the continuous monitoring of biomolecules in the interstitial fluid, such as alcohol or other substances.

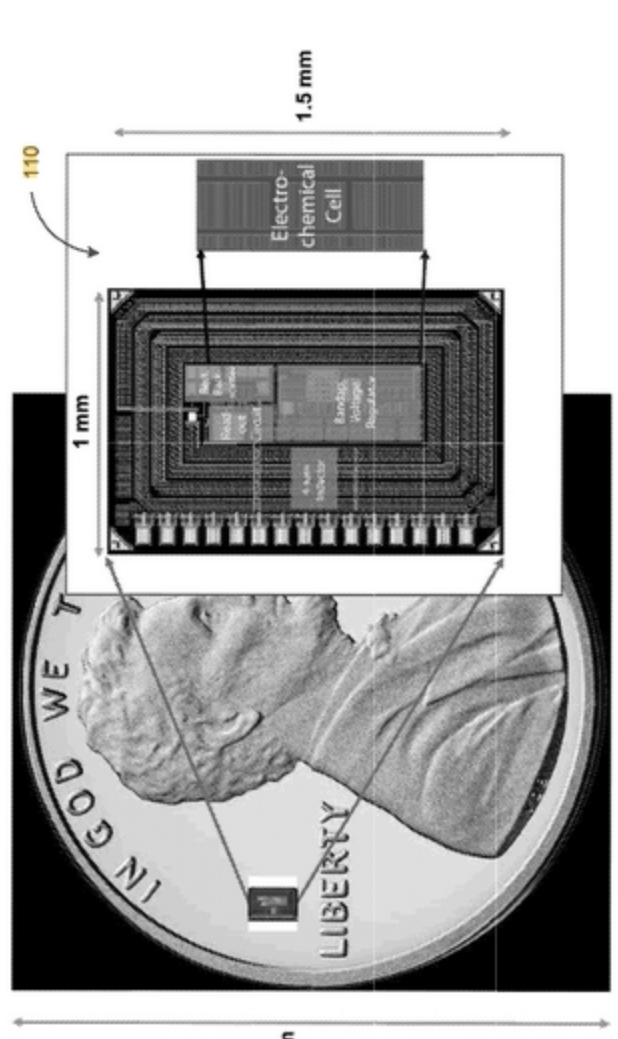
ADVANTAGES

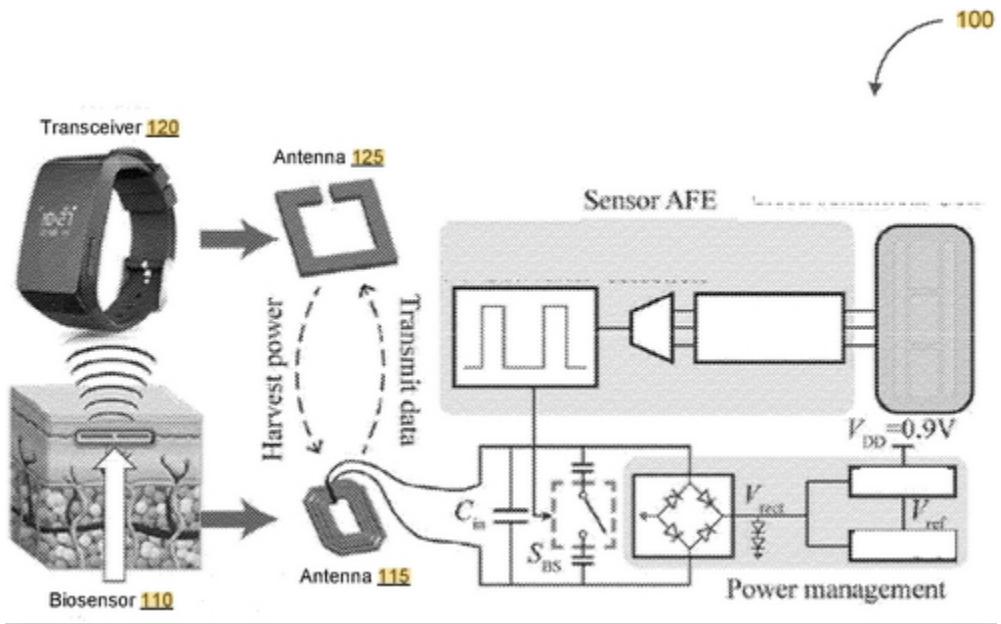
OTHER INFORMATION

KEYWORDS
implant, biosensor, wireless, potentiostat, Measuring characteristics of blood in vivo, analyte detection, electrochemical sensor, remote

CATEGORIZED AS
- Sensors & Instrumentation
  - Biosensors
  - Medical

RELATED CASES
2017-342-0





INTELLECTUAL PROPERTY INFO

UC San Diego is actively soliciting companies interested in leveraging this US (only) patented technology for biosensing applications. U.S.Patent No. 12,004,855

Below are just 3 of the allowed patent claims in the US patent application:

► **An apparatus, comprising:**

an electrochemical cell comprising a reference electrode, a control electrode, a first working electrode, a second working electrode, and a third working electrode, the electrochemical cell configured to perform a plurality of electrochemical measurements, the plurality of electrochemical measurements including a first measurement of an analyte concentration in a body fluid, the first measurement corresponding to a first current flow between the first working electrode and the control electrode, a second measurement of a

background interference present in the body fluid, the second measurement corresponding to a second current flow between the second working electrode and the control electrode, and a third measurement of a pH level within the body fluid, and the third measurement corresponding to a voltage difference between the third working electrode and the reference electrode;

a potentiostat coupled with the electrochemical cell, the potentiostat comprising at least a first current control loop configured to limit the first current flow between the first working electrode and the control electrode to a maximum current so as to reduce power consumption, wherein the maximum current is determined by a range of physiological levels of the analyte concentration present in the body fluid;

a current-starved diode connected differential transconductance amplifier configured with an overall transconductance to match a physiological pH level range present in the body fluid; and

an antenna configured to respond to one or more radio frequency waves output by a transceiver by at least transmitting, to the transceiver, a backscatter signal encoding a result of the plurality of electrochemical measurements, the backscatter signal exhibiting a cyclical pattern generated by selecting between the first current flow, the second current flow, and the voltage difference, the cyclical pattern including comprising a first quantity of cycles that correspond to the pH level, a second quantity of cycles that correspond to the analyte concentration, and a third quantity of cycles that correspond to the background interference, the apparatus being wirelessly powered by the one or more radio frequency waves instead of an onboard power source in order to minimize a first size of the apparatus, the one or more radio frequency waves having a high frequency such that the first size of the apparatus is further minimized by minimizing a second size of the antenna.

► The apparatus of claim 1, wherein the apparatus is **a subcutaneous implant.**

► A **method** comprising:

performing, by an electrochemical cell, a plurality of electrochemical measurements, the plurality of electrochemical measurements including a first measurement of an analyte concentration in a body fluid, the first measurement corresponding to a first current flow between a first working electrode and a control electrode, a second measurement of a background interference present in the body fluid, the second measurement corresponding to a second current flow between a second working electrode and the control electrode, and a third measurement of a pH level within the body fluid, and the third measurement corresponding to a voltage difference between a third working electrode and a reference electrode;

matching an overall transconductance of a current-starved diode connected differential transconductance amplifier with a physiological pH level range present in the body fluid; and

limiting, by a current control loop of a potentiostat, the first current flow between the first working electrode and the control electrode to a maximum current so as to reduce power consumption, wherein the maximum current is determined by a range of physiological levels of the analyte concentration present in the body fluid.

RELATED MATERIALS

- Jiang, Haowei & Zhou, Xiahan & Kulkarni, Saurabh & Uranian, Michael & Seenivasan, Rajesh & A. Hall, Drew. (2018). A Sub-1 µW multiparameter injectable BioMote for continuous alcohol monitoring. 1-4. 10.1109/CICC.2018.8357045. - 05/10/2018
- By Charlie Osborne for Between the Lines. Sensors under the skin monitor your alcohol intake . ZDNET - 04/11/2018

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Published Application	0196921-A1	06/25/2020	2017-342

Additional Patent Pending

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