Reagentless biosensors to detect multiple analytes

Unmet Need

Although biosensors are in widespread use to detect and report analytes, such as the level of nutrients in food and beverage samples, blood glucose in patients, and contamination in water samples, many suffer from deficiencies that limit their usability, or are ad hoc technology solutions that exploit fortuitous properties of a particular biomolecule, limiting the ability to systematically build product development pipelines. For instance, many sensor systems deploy enzymes that require additional reagents as part of the detection, resulting in relatively complex detection schemes; many deploy proteins that are not robust, requiring cold-chain distribution systems; many require that the analyte is presented in a narrow concentration range. The Duke fluorescent biosensors present a solution that is reagentless, robust, simple, and generalizable, capable of meeting analyte detection needs in many different fields of use.

Technology

Duke inventors have developed a suite of reagentless biosensors for monitoring multiple analytes either singly or in combination. This technology is intended for multiple applications in medical diagnostics, food and beverage safety and development, and industrial, environmental, and research settings. Specifically, the inventors have developed a suite of fluorescently responsive biosensors based on engineered ligand-binding proteins derived from bacteria. These biosensors can accurately determine analyte concentrations continuously or episodically using small samples by direct contact and do not require multiple, additional reagents. Furthermore, the sensors are typically based on thermophilic proteins, and therefore

are robust. These features enable simple, low-cost fabrication, distribution, and operation.

To date, biosensors have been developed to detect the levels of various analytes including glucose, lactate, galactose, glutamate, urea, bicarbonate, calcium, creatinine, chloride, and potassium. The suite of available analytes is extensible by a bioinformatic discovery process of new ligand-binding proteins devised by the inventors. The single fluorophores incorporated into the biosensors report on analyte concentrations by detecting local internal protein conformations, via a mechanism determined by the inventors. Conversion of a ligand-binding protein into a fluorescently responsive biosensor is achieved by protein design methodologies created by the inventors. This fluorescent response mechanism encodes an analyte-dependent color switch, resulting in self-calibrating ratiometric signals. The inventors also have developed a straightforward immobilization method that simplifies incorporation of the biosensors into instrumentation such as optodes for continuous monitoring or disposables for point-of-care measurements.

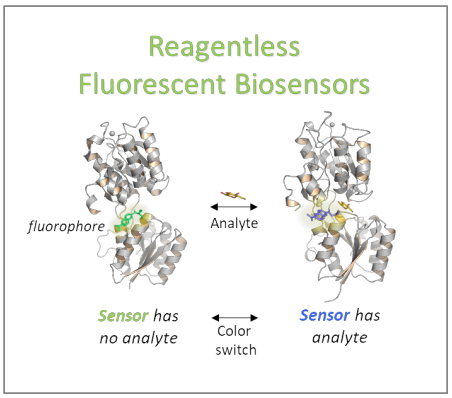
Applications

This technology can be used in point-of-care clinical diagnostics, continuous monitoring of patient status (including animals in veterinarian practice), wearable devices, sample monitoring in process engineering, agricultural technology, and environmental monitoring.

The technology can also be used as a research tool. For example, these biosensors can be developed into a kit to measure analytes in vitro.

Advantages

- Rapid episodic measurements with small samples
- Continuous sample monitoring



- Amenable both to low-cost point-of-care testing and high-value continuous monitoring system
- Low-cost, robust manufacturing
- Robust, simple distribution chain that does not require specialized handling or temperature control.
- Extensible for developing diagnostic technology pipelines

Duke File (IDF) Number

IDF #:T-002162

Meet the Inventors

Hellinga, Homme

Contact For More Info

Ferguson, Christy
919-681-7581
christy.ferguson@duke.edu

Department

Biochemistry

Publication(s)

•••••

External Link(s)

• From the lab of Dr. Homme W. Hellinga
• Issued US Patent (US15/776,6747) (thermostable glucose biosensor)
• Issued US Patent (15/777,061) (lactate biosensor)
• Published PCT Patent Application (PCT/US2016/062960) (urea biosensor)
• Issued US Patent (US15/776,725) (glucose and galactose biosensor)
• Issued US Patent Application (US15/776,871) (bicarbonate and calcium biosensor)
• Issued US Patent (US15/555,064) (glucose and galactose biosensor and development methods)
• Issued US Patent (US15/487,665) (glutamate biosensor)
• Issued US Patent (US12/954,317) (protein engineering method)