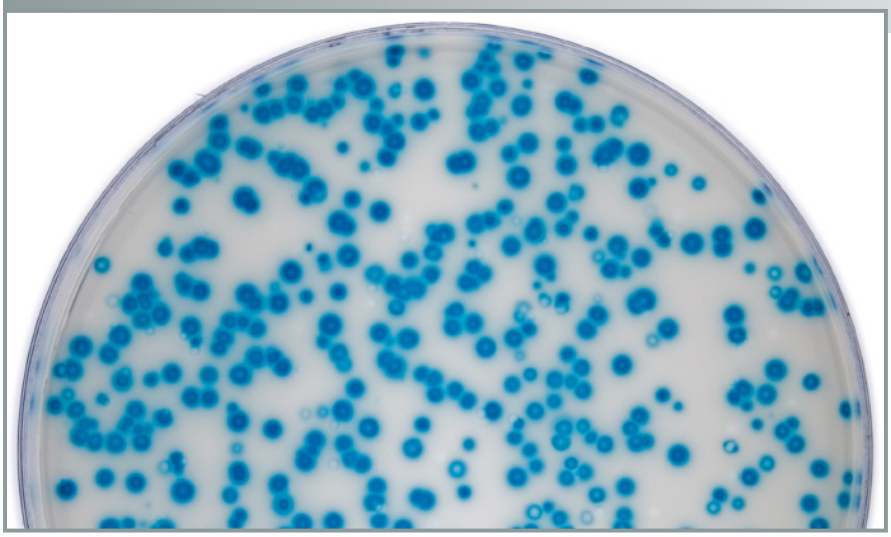
Bioluminescent Bioreporter Integrated Circuits

UT-B ID 199700370



Technology Summary

To address the need for fieldable real-time biological recognition systems, ORNL researchers developed a "laboratory on a chip" using genetically engineered whole cell biosensors attached to integrated circuits (ICs). These bioluminescent bioreporters can be deployed to assist with environmental detection and analysis during natural and human disasters.

While biosensors have been in use for decades, current devices have serious drawbacks, including an inability to work in real time outside laboratory settings. In addition, many current biosensors are too expensive, bulky, or delicate to deploy in remote locations and don't provide a secure microenvironment for the bioorganisms. ORNL bioluminescent bioreporter integrated circuits (BBICs), developed to address these drawbacks, can be used for environmental monitoring, tracking of bioremediation efforts, in vivo disease detection and tracking, water and food quality testing—virtually any application requiring accurate, inexpensive remote sensing where size and durability are considerations. Prototypes of the ORNL BBIC have been successfully used for rapid detection of microbial metabolites in enclosed spaces such as would be encountered when detecting fungal growth in wall cavities or volatile compound emissions from building materials or cleaning products.

The BBIC consists of two main parts: the bioreporter and the electronic circuitry to detect, record, and communicate the response of the bioreporter. The bioreporter is a bacteria genetically engineered to produce light when a particular substance is encountered or metabolized. The bioreporter is encapsulated in a polymer matrix above a photodiode on the IC, allowing the gas or fluid being sampled to reach the bioreporter and emitted light to reach the photodiode. The IC is a standard complementary metal-oxide semiconductor, selected for its low power consumption, low cost, and miniaturization capabilities. Depending on the application, the device may also include a current-to-frequency converter, digital counter, and wired or wireless transmitters, as well as nutrient reservoirs and microfluidic pumps to provide nutrients to the bioluminescent bacteria.

Advantages

- Rugged, inexpensive, and easily deployed
- Can record in real time
- Can be used in remote monitoring
- Highly sensitive (parts per billion)
- No radioactive materials used
- Can be deployed at multiple locations and networked
- Capable of housing multiple bioreporters

Potential Applications

- Rapid detection of contaminants
- Groundwater and/or hazardous chemical monitoring
- Environmental pollutant detection
- Food and water quality testing
- Oil exploration
- Drug discovery
- Industrial process control

Patents

Michael L. Simpson, Gary S. Sayler, Michael J. Paulus. *Bioluminescent Bioreporter Integrated Circuit,* U.S. Patent US 6,117,643, issued September 12, 2000; U.S. Patent US 6,905,834B1, issued June 14, 2005; U.S. Patent US 7,090,992B2, issued August 15, 2006; U.S. Patent US 7,208,286B2, issued April 24, 2007; U.S. Patent US 7,371,538B2, issued May 13, 2008.

Inventor Point of Contact

Michael L. Simpson
Center for Nanophase Materials Sciences Division
Oak Ridge National Laboratory

Licensing Contact

David L. Sims
Technology Commercialization Manager, Building, Computational, and Transportation Sciences
UT-Battelle, LLC
Oak Ridge National Laboratory
Office Phone: 865.241.3808
E-mail: simsdl@ornl.gov