Real Time Bacterial Water Sensors

OTT ID #1225

TECHNOLOGY

The inventors have utilized self-assembly of thermally-reduced monolayer graphene oxide (TRMGO) nanosheets on photolithographically patterned gold electrodes for highly sensitive detection of *E. coli* 0157:H7. This fabrication method by a solution process is suitable for mass-production of GO field effect transistor (FET) sensors. The TRMGO FET device shows great electronic stability and high sensitivity to *E. coli* cells with a concentration as low as 10 CFU per milliliter. The inventors have shown that this immunosensor has high sensitivity with a short response time as well as high reproducibility.
One of the most dangerous food borne and water borne pathogens is *E. coli* 0157:H7. This strain of bacteria causes symptoms such as bloody diarrhea, hemorrhagic colitis, and kidney failure. It is highly virulent and is infectious with a very low dose such that 10 to 100 CFU can lead to infection. Current methods for monitoring this pathogen in food production and water include a culturing and colony counting method, polymerase chain reaction, and immunological methods. These methods have low sensitivity, less specificity, and are time-consuming. The TRMGO FET device is an attractive replacement for these methods due to its rapid response, high sensitivity, and ability for real-time monitoring.

FEATURES/BENEFITS

- **Faster** – Rapid response for real-time monitoring of the environment
- **Ultra-sensitive** – Detection of *E. coli* concentrations as low as 10 CFU per mL
- **Scalable** – Fabrication can easily be scaled up with good reproducibility and high electrical stability
- **Inexpensive** – Materials utilized are relatively inexpensive
- **In situ Detection** – Sensors can be placed directly in a water system for immediate detection

INTELLECTUAL PROPERTY

Related Patents:

8,268,405 Controlled Decoration of Carbon Nanotubes with Aerosol Nanoparticles
8,240,190 Ambient Temperature Gas Sensor
US-2012-0214172-A1 Graphene-Based Field-Effect Transistor Biosensors
The UWM Research Foundation has licensed the above patents to NanoAffix Science, LLC (http://www.nanoaffix.com/) and together the parties are working find additional partners to develop the technology into a final product. This technology is available for developmental research support and licensing.

PAPERS

Chang J, Mao S, Zhang Y, Cui S, Zhou G, Wu X, Yang CH, Chen J. 2013. Ultrasonic-assisted self-assembly of monolayer graphene oxide for rapid detection of Escherichia coli bacteria. Nanoscale 5(9): 3620. S. Mao, G. H. Lu, K. H. Yu, Z. Bo, and J. H. Chen*, "Specific Protein Detection using Thermally Reduced Graphene Oxide Sheet Decorated with Gold Nanoparticle-antibody Conjugates," *Advanced Materials* **22**(32), 3521-3526, 2010.

UWM RESEARCH FOUNDATION

Technology Overview

MARKETS

Demand for water has increased rapidly over the past four decades, more than doubling as population growth has driven increased use for agriculture, industry and domestic purposes (Innovaro The Global Water Outlook 2013). As of 2010, most water infrastructure remained perilously old and almost entirely "dumb", i.e. incapable of automatically sending or receiving any sort of communications with its operators (2010 Innovaro Technology Foresight). According to the EPA, much of the US is relying on pipes that are more than one hundred years old. The EPA notes that around 3.5 million Americans become ill annually from bacteria and other toxins released from sewage spills.
The water market represents one of the largest business sectors with global revenues around $550 billion (2010 Innovaro Technology Foresight). It was estimated that in 2010, $89 billion would be spent globally on capital equipment for water collection, treatment, and distribution. The global environmental sensor and monitoring market was valued at $11 billion in 2010 and was predicted to reach $15.6 billion in 2016 (BCC Research).

INVENTORS

Junhong Chen Ph.D.
Dr. Junhong Chen is a Professor of Mechanical Engineering and Materials Science and Engineering at UW-Milwaukee. His research focuses on nanoparticle synthesis, assembly, and nano-fabrication, specifically in the area of carbon nanotubes and hybrid nanomaterials. The materials developed in Dr. Chen's lab are characterized and have been applied to applications including nanostructure-based gas sensors, biosensors, lithium-ion batteries, supercapacitors, solar cells, liquid sensors, and water treatment. Dr. Chen is the director of both the NSF I/UCRC on Water Equipment and Policy and the Laboratory of Nanotechnology for Sustainable Energy and Environment.

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