A Nanotip Array Based Biological Pathogen Sensor

A portable, fast response pathogen detection system for use in hospitals, ports, or transportation centers.

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Inventor
Dr. Grover Larkins
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Field
Pathogen Detection

Technology
Nanotip array of biosensors

Key Features
- Real-time detection of deadly pathogens
- Portable, fast response in seconds

Stage of Development
Prototype in development

Status
Seeking development & licensing partner(s).

Patent Status
Patent pending

The invention is a real time pathogen detection system for detecting deadly pathogens such as anthrax, ebola, botulism, smallpox, among others. The system can also measure concentrations of the pathogen. The system is portable - if an external power source is available in the location it is to be used in, it can fit into a briefcase. Its response time is expected to be in tens of seconds. Additionally, the device produces no waste to dispose of and requires no reagents.

There are two modes of operation of this device:

1) As a stand alone physical sensor where the nanotip electrodes are charged with a bias to produce an electric field to adsorb the unknown species in the media (air, gas, vapor, liquid) on the tips. After adsorption the species, if large enough to bridge the gap between the tip and the ground plane, is swept with a bias and the current is measured and/or at the same time a photonic stimulus is applied and the response current versus applied bias and the wavelength of the photonic stimulus is measured. This allows a rapid, wide spectrum "smoke detector" type of response identifying the presence of a potential pathogen and highlighting possible species present.

2) As a loaded DNA or antigen type of highly specific pathogen sensor. In this mode of operation the nanotip electrodes of this device are biased to create a small electric field. This small electric field causes user introduced, pathogen species specific, DNA or an antigen to bind to the nanotip electrode. Subsequently, the unidentified potential pathogens enter the sensor chamber and bind to either the antigen or DNA fragment. The bias voltage on the nanotip electrodes is then swept while the pathogen is bound to the electrodes. The presence of the pathogen produces a characteristic change in the current vs. voltage response between the electrodes. Each pathogen will produce a signature response that is compared to a database of known and previously recorded responses to identify the pathogen. The DNA/antigen is selective in the first place, so the current-voltage response is secondary means for confirming the presence of the pathogen. A photonic stimulus can also be applied to the captured pathogen; voltage and current can then be measured as a function of the photonic stimulus wavelength as an additional means for identifying pathogens.

As noted in operation mode (1) above this device does not require either an antigen or a DNA segment to function as a detector with some degree of specificity. This makes it uniquely rapid, simple and versatile.

Opportunity

This device could be used in hospitals to detect the presence of pathogens. Additionally, it can be used as a counter-terrorist tool in locations such as ports, airports, subway stations, and other transportation centers. Additionally, it could be used by the military or other government forces in foreign locations due to its portability. Food and water safety applications may also be possible.

FIU is seeking a research and development partner for this technology.

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Inventor

Dr. Grover Larkins

Focus: Applied superconductivity and ultra-thin film electronics/physics, RF, optical, microwave and analog electronics.

B.S. Case Western Reserve University, 1981
M.S. Case Western Reserve University, 1982
Ph.D. Case Western Reserve University, 1986

Research Areas:

Thin Film Microelectronics
Applied Superconductivity
Electronic Properties of Materials
Device Physics
Future Aerospace Science and Technology: Center for Space Cryoelectronics

Dr. Larkins' current research interests are focused on the electronic properties of materials. Within this area he is actively pursuing research in applied superconductivity, thin film microelectronics and field-ion microscopy. He has ongoing national and international collaborative research projects with the Fritz-Haber Institute of the Max-Planck Society in Berlin, Germany and Xerox corporation's Palo Alto Research Center (PARC).

Among Dr. Larkins accomplishments are the first reported monomolecular tunnel-barrier Josephson junctions, first Metal-Langmuir-Semiconductor-Field-Effect-Transistor Integrated Circuits (MLSFET ICs) and the first reported observation of higher order inelastic tunneling in a tunnel diode with an ordered insulator. His more recent research efforts have led to the observation of aging effects and the establishing of aging time constants in high Tc superconductors. Present research includes investigation into the interaction of high Tc superconductors and ferroelectrics in the presence of an applied electric field (Superconducting Field Effect Transistors).

Dr. Larkins is currently responsible for teaching undergraduate Circuits, Electronics and Solid State courses and graduate level Applied Superconductivity, Electro Optic Devices and Circuits courses.