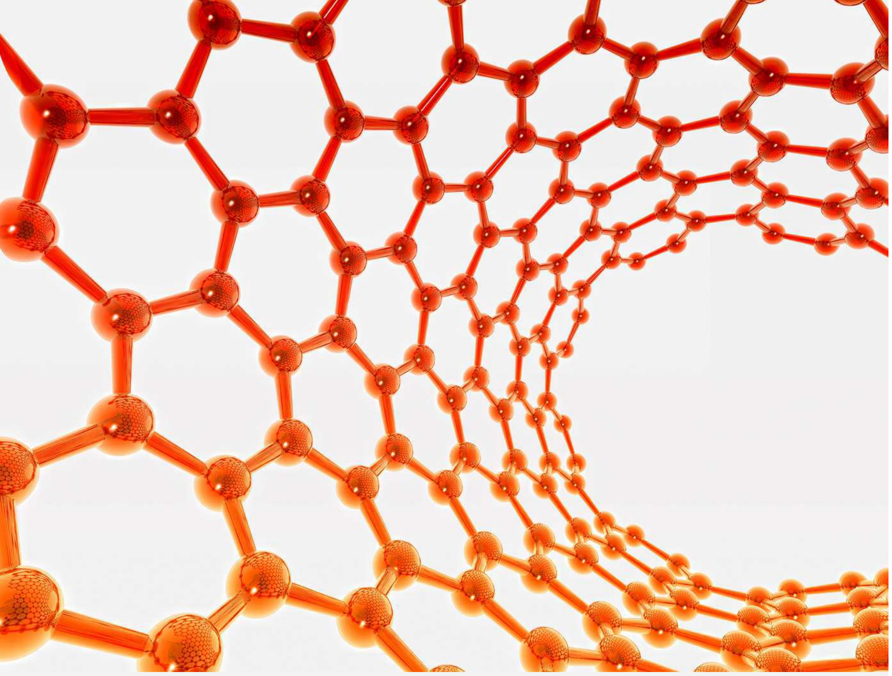

National Aeronautics and
Space Administration

technology solution

Sensors

Dielectrophoresis-Based Particle Sensor Using Nanoelectrode Arrays

Using dielectrophoresis (DEP) effects in a non-uniform, non-constant electrical field

NASA has developed a technology that uses nanostructure electrode arrays and non-constant electrical fields to sense the presence of a selected species particle. Sample preparation is one of the key functions in detection of biologically important organisms. It involves controlled separation, concentration, and/or manipulation of desired particles from a matrix of interferents. This new technology uses dielectrophoresis (DEP) effects in a non-uniform, non-constant electrical field, produced by an array of spaced-apart nanostructures (NSs) located on a substrate surface, to control particle separation. The object of the invention is to promote an accumulation/ concentration of the selected particles (e.g., biological species, such as E.Coli, salmonella, and anthrax , and non-biological materials, such as nano-and micro-particles, quantum dots, nanowires, nanotubes, and other inorganic particles) adjacent to the substrate. It also provides a sensor that detects presence of a selected species particle in the channel liquid or fluid.

BENEFITS

- Detection of multiple species
- Use for organic or inorganic species
- Low voltage operation
- Small size Lab-on-a-chip
- Good selectivity
- Does not require electrically charged species
- Usable for high speed microfluidic flows
- Provides greater electric field intensity gradient.
- Analysis automation
- Real time monitoring

THE TECHNOLOGY

A time-varying electrical field E, having a root-mean-square intensity of 2rms, with a non-zero gradient in a direction transverse to the liquid or fluid flow direction, is produced by a nanostructure electrode array with a very high magnitude gradient near exposed electrode tips. A dielectrophoretic force causes the selected particles to accumulate near the electrode tips, if the medium and selected particles have substantially different dielectric constants. An insulating material surrounds most of the nanostructure electrodes, and a region of the insulating material surface is functionalized to promote attachment of the selected particle species to the surface. An electrical property value Z(meas) is measured at the functionalized surface, and is compared with a reference value Z(ref) to determine if the selected species particles are attached to the functionalized surface. An advantage of this innovation is that an array of nanostructure electrodes can provide an electric field intensity gradient that is one or more orders of magnitude greater than the corresponding gradient provided by a conventional microelectrode arrangement. As a result of the high magnitude field intensity gradients, a nanostructure concentrator can trap particles from high-speed microfluidic flows. This is critical for applications where the entire analysis must be performed in a few minutes.

One of the applications of the technology is in the fields of research and chemistry laboratories

APPLICATIONS

The technology has several potential applications:

- Medicine
- Nanotechnology
- Biomedicine
- Analytical instruments
- Research and chemistry laboratories
- Environmental monitoring

PUBLICATIONS

Patent No: 7,635,420

More Information

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