National Aeronautics and Space Administration

Materials and Coatings

Aqueous Dispersion of Carbon Nanotubes and Their Application in Bionanotechnology and Fuel Cell Electrodes

Surfactant-less buffer solutions used to effectively disperse carbon nanotubes

NASA's Langley Research Center researchers have developed a novel method to disperse carbon nanotubes in aqueous solutions using chemical buffers. By avoiding the common use of surfactants to achieve dispersion, the researchers have provided a means to maintain biocompatibility of the carbon nanotubes, while also providing a means to functionalize the nanotube surfaces for specific biological and chemical activity. One particular example is the use of this approach to functionalize the surface with nano platinum catalysts to use as electrodes for fuel cells or biofuel cells. Additional surface functionality could provide use for biosensors or delivery of functionalized molecules for medical applications.

BENEFITS

- Provides effective dispersion of carbon nanotubes in aqueous solutions without the use of surfactants
- Maintains biocompatibility and imparts surface functionality of carbon nanotubes for medical applications
- Enables dispersion of carbon nanotubes and incorporation of platinum nanocatalysts for fuel cells and biofuel cells
- Maximizes efficiency of platinum catalyst to minimize costs
- Provides simple processing steps and use of commercially available buffer solutions
- Offers long-term stability of dispersion
- Has been successfully demonstrated in laboratory experiments
- Patent applications filed

technology solution

THE TECHNOLOGY

The NASA technology for aqueous dispersion and functionalization of carbon nanotubes, and their subsequent use for biological or fuel cell applications, is based on the use of buffers. Experiments conducted using morpholino-propane sulfonic acid (MOPS) demonstrated effective and simple dispersion of carbon nanotubes (single and multi-wall carbon nanotubes) in aqueous solutions, at concentrations up to 1 mg/ml. Key to the dispersion technology is it simplicity, speed, stability, and most of all, its avoidance of the use of surfactants or organic solvents. Furthermore, the NASA researchers demonstrated that this process enables the addition of certain molecules to impart specific functionality to the carbon nanotubes, while maintaining biocompatibility. For example, iron and platinum-cored ferritin proteins were successfully populated at high density onto the carbon nanotubes.

The NASA technology could be applied in the medical field.

APPLICATIONS

The technology has several potential applications:

- Carbon nanotube papers prepared from aqueous solutions
- Fuel cell and biofuel cell electrodes
- Medical use of carbon nanotubes for delivery of therapeutics or diagnostics
- Functionalized carbon nanotubes for catalytic and other chemical processes
- Nanomedicine
- Nanocatalysts and catalyst supports
- Nanocomposites via aqueous processing

PUBLICATIONS

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More Information

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