Technology Opportunity
Glenn Research Center • Cleveland • Ohio
Technology Transfer & Partnership Office

TOP3–00184

Nanorod Material Development for Fast Response Luminescent Pressure Sensor Applications

Technology

The National Aeronautics and Space Administration (NASA) seeks to transfer technology for an instrumentation/material application based on pressure-sensitive paint (PSP) techniques.

Benefits

- Optical two-dimensional (2–D) imaging data acquisition
- Fast responding optical oxygen sensors
- Nanofabricated structural or optical platform
- Wireless "point-and-shoot" laser-interrogated pressure-sensitive coating
- Improves pressure measurement response up to 50kHz

Commercial Applications

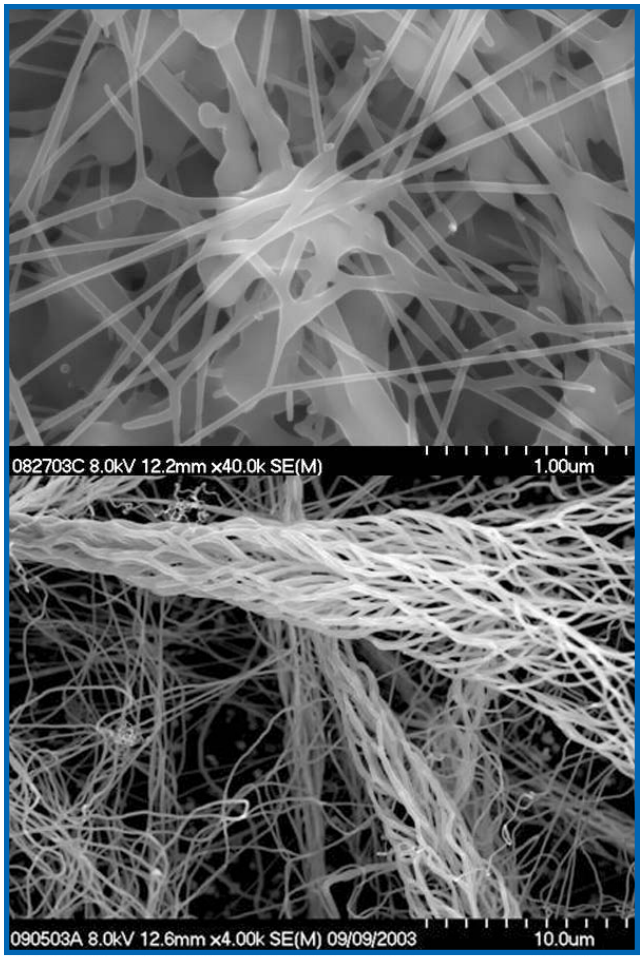
- Aerodynamic research and development
- Automotive and motorcycle development and testing
- Optical oxygen sensors
- Nanofabricated structural or optical platform

Technology Description

The PSP technique is based on oxygen quenching of photoluminescence. The intensity of the emitted light is inversely proportional to the partial pressure of oxygen. The technique allows data acquisition from both areas of interest through imaging methods or single point interrogations through scanned laser methods. The potential use of PSP in fast response applications (5 to 10 kHz) is very promising but requires the response time of the coating to be faster than most polymer-based PSPs can deliver.

A typical PSP consists of a photoluminescent oxygen sensor encased in a gas permeable binder, often some kind of polymer. The response time to fluctuating air pressure is limited by the diffusion of air in and out of the PSP coating. Several methods have been explored in reducing the time response of PSPs that include very thin applications, loading polymers with solids, solgels, and open PSPs such as ceramics and anodized aluminum. The goal of building a faster responding sensor is to use an exoskeletal structure, which will improve the porosity of the structure by a hundredfold over polymer coatings. This novel approach to building an open PSP structure will not only hold the photoluminescent oxygen sensor but will allow very fast response to fluctuating pressures. As opposed to the ultrafast anodized aluminum open structure that is etched into the surface as microscopic holes, the nanorod structure is a designed nanoscale exoskeletal structure on the surface through the synthesis of silicon or silicon dioxide nanorods.

The nanorod approach is looking at synthesizing two different structures to host the oxygen sensor. The regularly oriented mat approach uses a structured array in a common orientation whereas the entangled mat concept is a more random or interwoven structure. Both structures provide a much greater exposed surface area by a hundredfold over other open PSPs and an even greater exposed area over other open PSPs and even a greater exposed area over polymer-based binders. Other unique structures have been synthesized that have weblike or braided structures that could have the added benefits of being more robust or potentially lead to nanosensors such as nanotufts or shear sensors.



Two different types of silicon nanorods, entangled mats and interwoven nanorods, synthesized as potential substrate for luminescent pressure or other flow sensors.

Options for Commercialization

The NASA Glenn Research Center is interested in working with industry and academia to further develop this instrumentation/material technology and develop new applications for this novel technique.

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Key Words

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