An Implantable Glucose Sensor Based on Single Walled Carbon Nanotube Fluorescence
Technology #13418

Applications

- Implantable sensors for real time monitoring of various biological compounds, e.g., glucose, glutamate, etc.
- Implantable therapeutic drug monitoring (TDM) devices for drugs with narrow therapeutic indices or widely variable pharmacokinetic profiles
- Implantable sensors for veterinary use, both for livestock (breeding, health management) and companion animals (diabetes care, monitoring of seizure medications)
- Sensors for point-of-care devices to replace standard laboratory testing in hospitals, nursing homes, and in frontline military medical units

Problem Addressed

This technology provides a new method for sensing biomolecules by using single-walled carbon nanotube fluorescence.

Technology

Molecular detection using near-infrared light between 0.9 and 1.3 eV has important biomedical applications because of greater tissue penetration and reduced auto-fluorescent background in thick tissue or whole-blood media. Carbon nanotubes have a tunable near-infrared emission that responds to changes in the local dielectric function but remains stable to permanent photo-bleaching. Here, the synthesis and successful testing of solution-phase, near-infrared sensors, with β-D-glucose sensing as a model system, is presented. The current technology uses single-walled carbon nanotubes that modulate their emission in response to the adsorption of specific biomolecules. Through the use of non-covalent functionalization, adsorbed electroactive species can react selectively with a target analyte to modulate the fluorescence of the nanotube. Carbon nanotubes are excellent NIR fluorophores with good photo-stability and tunable excitation and emission wavelengths which are dependent upon the nanotube’s geometric structure. NIR excitation and emission in such a nanoscale device allows for greatly enhanced penetration and negligible auto-fluorescence encountered in thick tissue or unseparated blood samples - thus allowing for highly accurate, real time in vivo sensing. Proof of concept has been demonstrated with a glucose sensor in blood serum. It is envisioned that this sensor could be implanted into a patient and be activated and read by a NIR excitation and detection instrument fashioned into a "watch-like" device. Beyond glucose sensors, this technology suggests new opportunities for nanoparticle optical sensors that operate in strongly absorbing media of relevance to medicine or biology.

Advantages

- Real time biofeedback capabilities
- Can be used in strongly scattering media
Enhanced penetration (centimeters) and negligible auto-fluorescence in thick tissue or blood
Not susceptible to photo-bleaching - SWCNTs exhibit good photo-stability
Multi-channeled sensors are possible in order to detect numerous compounds simultaneously

Categories For This Invention:

Medical Devices
Diagnostic
Life Sciences
Diagnostics

Intellectual Property:

Sensors employing single-walled carbon nanotubes
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An implantable glucose sensor based on single walled carbon nanotube fluorescence
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Publications:

Near-Infrared Optical Sensors Based On Single-Walled Carbon Nanotubes
Nature Materials
4, 86 - 92 (2005)

External Links:

Strano Research Group
http://srg.mit.edu/

Image Gallery: