First In Vivo Surface-Enhanced Raman Glucose Sensor

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Technology description

With diabetes mellitus, the body either fails to produce or to respond to insulin, which regulates glucose metabolism, resulting in large fluctuations in blood glucose levels. These fluctuations can cause a range of serious complications. Treatment generally consists of self-regulation of blood glucose levels through frequent monitoring, diet, medication, and insulin injection. Most patients measure their glucose levels by withdrawing small samples of blood using a "finger-stick" apparatus followed by electrochemical detection of a glucose oxidation product. This measurement is painful, inconvenient and can result in uneven monitoring with risk of secondary complications. A new blood glucose assay addressing these issues is desirable.
Ex vivo glucose was quantitatively assayed with EG3 self assemble coated AgFON substrates, mounted into a small volume flow cell. EG3-modified AgFON sensors were incubated in saline solution (pH = 7.4) containing glucose concentrations from 0-450 mg/dL (0-25 mM). A HeNe laser was used to produce the 632.8 nm excitation wavelength and the SERS spectra measured. The EG3-modified AgFON sensor quantitatively detected glucose over the physiological range examined.

In vivo analysis was also demonstrated with a fiber optic SERS glucose sensor surgically implanted in diabetes induced Sprague-Dawley rats. Raman spectra were collect via the optical fiber as the glucose levels of the rats were varied by injection of glucose or insulin and compared versus a standard laboratory glucose assay. The SERS measurements fell within the acceptable range and the data compared favorably with the previous in vitro results. The biosensor system has been demonstrated for blood glucose monitoring and promises similar potential for other critical biological analytes.

Application area

The present invention provides surface-enhanced Raman (SERS) biosensors for the detection of in vivo and ex vivo analytes such as blood glucose. A novel method for increasing glucose interaction with the silver film over nanospheres (AgFON surface employs a self-assembled monolayer (SAM) on the film surface to reversibly pre-concentrate the analyte. The nanobiosensor is configured for the quantitative detection of the analyte, and can be utilized for in vivo detection by implantation for detection of bodily fluid analytes.

Advantages

A potentially faster, easier, and less painful method for frequently measuring blood glucose levels of individuals is provided. Continuous monitoring of blood glucose would facilitate feedback control of implanted insulin pumps and related devices.

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