CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

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Project Number

S0503

Project Title

Glucose Monitoring in Porous Silicon Photonic Crystals

Abstract

Objectives/Goals

Porous silicon as a sensor is useful in many applications throughout the real world, from monitoring toxins and chemicals in the environment to sensing proteins and hormones in the body that can indicate the onset of fatal heart attacks. One situation in which sensors are critical is diabetes, a disease in which the level of blood sugar, or glucose, is dangerously high.The purpose of this project is to determine a relationship between the concentration of glucose molecules in a solution and the amount of shift in the visible light spectrum of a porous silicon chip.

Methods/Materials

A porous silicon chip was prepared by immersing a regular silicon wafer in a solution containing aqueous hydrofluoric acid, and exposing it to an electric current defined in a computer program. After the chip was submerged in solutions of varying concentrations of glucose and the spectrum was taken, various computer programs were used to analyze the peak wavelengths and determine their relationship with the glucose concentrations. Materials used included a Teflon etch cell, aspectrometer with tungsten halogen lamp as a light source, petri dishes, and pipettes, among others.

Results

A distinct shift was observed between the peak wavelength of spectra in air and the peak wavelength of spectra in the solutions. The relationship between the glucose concentration and the wavelength of light of the peak was observed to be positively associated and linear. As a control, the peak wavelengths of the spectra were taken in air between each solution, and they remained unchanging throughout each trial.

Conclusions/Discussion

Because consistent results displaying a linear relationship between glucose concentration and peak wavelength were obtained, the discovery of such a relationship reinforces the usefulness of porous silicon as a sensing material and perhaps provides the foundation for a new chemical monitoring device, since the concentrations of various substances in a solution can then be detected and monitored based on the shift in the visible light spectrum of the chip. The chip itself was also confirmed to be an successful sensing device because the peak wavelengths of the porous silicon chip in air remained stable, which shows that the surface chemistry of the chip remained stable.

Summary Statement

A porous silicon chip was etched and used to monitor glucose levels in aqueous solutions as a potential new sensor for diabetics and to explore the stability and effectiveness of porous silicon in sensing applications.

Help Received

Used lab equipment at the University of California, San Diego under the supervision of Professor Michael Sailor and mentor Jennifer Park