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Developing an implantable optical glucose sensor for monitoring glucose concentration

Optical biological sensors are becoming very popular for use in detecting many different kinds of analytes of interest for medical diagnostics. There are optical sensors available today to detect many things from blood enzymes to glucose. Glucose sensors represent an important component in a diabetic's arsenal. However, an implantable glucose sensor that would last longer than three days does not exist. Implantable sensors that possibly hold the most promise for diabetics are those that are extremely small and can be implanted inside cells to take constant measurements. I have been working on a biological sensing system to detect changes in the glucose level at the intracellular level. An oxygen-sensitive ruthenium dye has been encapsulated in special low-temperature glass beads using the sol-gel fabrication process. The beads are billionths of a meter in diameter. When the dye-containing beads are placed in a cuvette with glucose oxidase and glucose, the enzyme metabolizes glucose and oxygen to form hydrogen peroxide and D-gluconolactone. The depletion of oxygen by the enzymatic reaction enhances the dye's fluorescence. The change in signal intensity has been measured with a spectrofluorometer and converted into the glucose concentration. I am currently working on inserting the beads into red blood cells. Red blood cells allow glucose to diffuse through its membrane and interact with the ruthenium dye labeled beads while protecting the beads from biofouling. This sensing system could prove to be invaluable technique to avoid loss of signal due to biofouling and extend the lifetime of implantable sensors.