MEDICAL TECHNOLOGY

What do MEMS and Diabetic Glucose Sensors have in Common?

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Today's most common method of monitoring blood glucose levels is using the fingerprick method, which is invasive and requires disposable glucose sensors. This method is used by diabetics to withdraw a drop of blood (usually from a finger) and measure its glucose content. It is recommended by doctors to perform this method 6 to 8 times a day to prevent hypo- and hyperglycemic symptoms from appearing, such as loss of consciousness and gangrene.

It is well-known that the pricking method does not provide fully-reliable readings, and it poses financial problems to patients. Other problems such as skin inflammation and damage are due to frequent skin puncturing. Psychological problems can arise as well, which stem from the issue of performing glucose measurements in front of people and becoming noticeable. On the other hand, the research for the ideal, artificial pancreas counts heavily on the performance of an implanted glucose sensor, which has to perform continuous, reliable and long-term blood glucose measurements. Up to this day, the issue of reliability has not been solved, but MEMS may offer diabetics a better chance.

MEMS stands for MicroElectroMechanical Systems, which exploit the conversion of mechanical energy to electromagnetic energy. MEMS research is in its infancy stage, and it is an area of hot research.

MEMS glucose sensors is one of the sensor types being examined by Dr. Rafael Kleiman, a McMaster University Professor and Research Chair in MicroElectroMechanical Systems. The fundamental idea is to have glucose bind to an enzyme that is immobilized on the surface of a MEMS caterpillar, which causes deflection (see Figure 1). When the binding occurs, the change in mechanical energy and overall mass drop the structure's resonant frequency. Such a change is proportional to the bound glucose concentration, and an electromagnetic signal is sent from the glucose-bearing caterpillar to a monitoring device found on the diabetic's body.

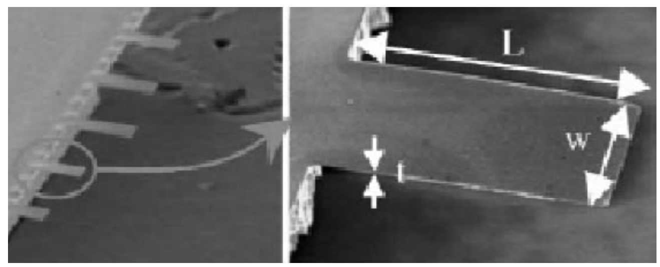

Figure 1. An array of caterpillars with surface are to immobilize glucose-binding enzyme

The caterpillar is built in the micro-range for possible usage in long-term implantation of 10-15 years, such as for an artificial pancreas. Also, it can be imagined to have this sensor capsulated in a tablet for the diabetic to swallow, and when the sensor enters the cardiovascular system, it can anchor itself onto a blood vessel's interior wall. This enables a diabetic to perform continuous, non-invasive glucose measurements.

Some of the main obstacles are the issues of biocompatibility and long-term stability in body temperatures, given that the functioning of enzymes drops with high temperatures and pH levels. Scientists have been partially successful in genetically modifying enzymes and proteins from E. coli, in order to give them superior properties to handle the body's interior environment. MEMS glucose sensor may see light in the near future to make a difference in the lives of diabetics.

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