Columbia Technology Ventures

MEMS Based Implantable Glucose Sensor for Diabetes

“Lead Inventors: Qiao Lin, Xian Huang, Quian Wang, Jerome S. Schultz

STV Reference: IR M09-070, M09-071, M09-072

MEMS glucose sensor implant monitors glucose levels in diabetic patients. Continuous, real-time glucose monitoring and insulin dosing is critical to effectively manage Diabetes, mitigating its deleterious and serious health effects. Most monitoring is done using the pinprick method, employing strips and a detector. This requires a painful, invasive procedure, provides infrequent feedback regarding glucose levels, and leads to poor compliance and disease management. The technology presented here allows for continuous real-time monitoring via a compact, implantable device architecture, which can be coupled with an insulin pump to regulate glucose levels in Diabetic patients.

Implantable device coupled insulin pump regulates glucose levels in diabetic patients: The technology is an affinity based glucose sensor, which uses a glucose binding polymer incorporated into a Micro Electro-Mechanical System (MEMS) to dynamically monitor glucose concentrations in solution. Binding is reversible, and the mechanical and electronic properties of the polymer are altered, in a detectable way, by glucose binding. A resonating membrane, supported by the polymer, can be driven to resonate, its frequency monitored via a fluctuating capacitance signal, which is shifted depending the stiffness of the polymer and thus glucose concentration. The change in dielectric constant of the polymer can also be measured directly by capacitance to determine glucose concentration and eliminates the need to actively drive the device.

Applications: • This technology is most exciting as a continuous and possibly implantable glucose sensor paired with an insulin pump for real time monitoring and management of blood glucose levels in diabetic patients • Glucose content is a key parameter in the fermentation process for alcoholic beverages, and thus as part of a wireless sensor placed inside sealed fermentation tanks this device could be used to better monitor fermentation • Replacing the polymer matrix with polymers having affinities to other molecules allows its use as a more general sensor based on the same mechanism

Advantages: • The sensor is fully reversible unlike strips, and the polymer quickly comes to equilibrium with changes in glucose solution concentration allowing for continuous real time monitoring • The sensing element is monitored (read) entirely electronically and by a straightforward output parameter (capacitance) allowing for simple detection electronics and a compact device • Due to the on chip integration and small size of the overall device it lends itself to use as a minimally-invasive implantable blood glucose sensor


Publications: A MEMS affinity glucose sensor using a biocompatible glucose-responsive polymer, Xian Huang, Siqi Li, Jerome S. Schultz, Qian Wang, and Qiao Lin, Sensors and Actuators B: Chemical, Volume 140, Issue 2, 16 July 2009, Pages 603-609”
Inventors

Qiao Lin