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From mining exploration to glucose monitoring

Micromem developing magnetic, non-invasive glucose sensor

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Continuous glucose monitors (CGM) have been proven to improve the health of people with diabetes (*Medical Device Daily*, Sept. 12, 2008). Several on the market already avoid the painful, repeated fingersticks, but they are still invasive, albeit more comfortable. A new technology that uses the power of magnetic sensors is a totally non-invasive approach.

Micromem Applied Sensor Technologies (MAST; New York), a subsidiary of **Micromem Technologies** (Toronto), is transferring what it has learned in mining exploration to non-invasively "see" glucose levels under the skin, enabling diabetics to continuously monitor blood sugar with a device that will look like a wristwatch.

The technology magnetoresistive random access memory (MRAM) is Micromen's segue into the medical device business with its extremely sensitive sensor now in development.

"Our first sensor was for mining exploration for minerals," Micromem President Steven Van Fleet told *MDD*. "Exploration for minerals is expensive. Drilling costs millions. Our technology is based on the fact that everything on earth – gold or blood – has a magnetic signature. We developed a sensor array that can determine what's in those core samples from the ground. As the core comes up out of the ground we pass our sensor right over the core and we can give the well exploration company an indication of what minerals are in there right away, rather than the typical two to three months it takes in a lab."

In the process of developing the prototype for mining exploration, a partner company asked Micromem to look at other potential applications.

"Somebody suggested that we should look at glucose," said Van Fleet, himself a Type 2 diabetic. "People are trying to get away from invasive technologies. I don't like sticking my fingers four times a day. So we did some early work in the lab using glucose samples from a medical company we're working with. We were able to tell them the percent of glucose in there right away."

That's when the project to develop a CGM was set in motion.

MRAM is a memory technology that retains stored data even when the power is turned off with properties that differentiate it from conventional silicon memory.

"Our technology uses a hall sensor [a transducer that varies its output voltage in response to changes in magnetic field]," he said. "When you move electricity through a wire, a magnetic field is generated around. A hall sensor will detect that field. When you power it one way, the magnetic field goes north south and hall sensor detects that movement. When you take the power off, the magnetic coils keep the memory intact."

Van Fleet also said the technology makes use of gallium arsenite (GA) rather than silicon. GA is much more expensive than silicon, so "Our marketplace isn't the traditional memory market like cell phones because the price point is higher. We're focusing on niche markets with this extremely sensitive magnetic sensor."

Micromem is working with an early prototype that has proven *in vivo* it can see the magnetic signature of glucose.

The company is now working with an undisclosed partner to develop a more advanced prototype of the glucose sensor.

"Once we have demonstrated prototypes to people who are involved in diabetes, we'll have to collaborate with another company to further develop this," Van Fleet said.

The sensor are very small – 2 microns – which will allow the placement of hundreds into an array.

Although he didn't reveal a project price point, Van Fleet said the sensor would be very low cost. "We've got a sensitivity level unseen before and a cost-effective manufacturing technique. We will collaborate with people who have the deep expertise because we're not a glucose or gold mining expert."

Van Fleet envisions a wide range of medical device applications such as cancer detection, improved hearing aids, oxygen content monitoring, cholesterol level checks and pregnancy tests.

Micromem is seeking to overtake a market where there are just three FDA-approved CGMs, all relatively new:

• The FreeStyle Navigator GCM, made by **Abbott Laboratories** (Abbott Park, Illinois). The FreeStyle was just

approved in 2008. It is designed to continuously measure glucose levels through a sensor placed in the back of the upper arm or abdomen. The sensor, worn for up to five days and then replaced, is placed just under the skin and attached to a plastic sensor mount with adhesive to adhere to the skin, like a patch (*MDD*, March 14, 2008).

• **DexCom** (San Diego) reported in 2008 that it entered into a joint development agreement with Animas (West Chester, Pennsylvania) to integrate DexCom's CGM technology into Animas insulin pumps. The new product will be based on Animas' pump technology and DexCom's Seven, a seven-day CGM. It will enable the Animas pump to receive glucose readings and display this information on the pump's color screen. Users will have access to real-time glucose readings and trending in addition to receiving alerts for low and high glucose readings (*MDD*, Jan. 11, 2008).

• **Medtronic** (Minneapolis) was the first on the market in 2006 with a CGM product. The company received FDA approvals for the Guardian and the MiniMed Paradigm REAL-Time for use by adults (*MDD*, April 14, 2006). Then it received approval for use in children in 2007 (*MDD*, March 14, 2007). ■