



High tech gets wet

Written by Tim Lougheed for Science Alberta Foundation

From cell phones to flat screen televisions, our most sophisticated hardware generally prefers to stay cool and dry. It might not seem like a good idea to send liquid through the narrow channels that normally carry electrical signals, but that is exactly what drives one of Alberta's most promising areas of research and development.

And this work should change our lives as dramatically as digital music players and video games have done, giving us new options for such important tasks as testing your tap water or determining the dose of a drug you have been prescribed.

The technical name for this field is microfluidics, mixing tiny amounts of chemicals within the confines of what looks like a typical computer chip. Depending on the design, a complex series of reactions can be arranged; the result is a fast-paced, miniaturized version of events that would normally take place in a laboratory. Chemical processes that used to require time and a dedicated workspace can now be done almost immediately, wherever you bring this highly portable equipment.

And while consumers have yet to welcome any microfluidic innovations with the same fanfare that greeted the iPhone, this technology has been evolving steadily for more than two decades, yielding products that are starting to change the way environmental and medical testing is conducted. In fact, consumers are already taking advantage of microfluidics without necessarily knowing it, as these technologies improve the function of many other products.

"It's an industry that has grown a lot, and it still has a huge amount of potential," says Chris Lumb, President and CEO of Edmonton-based Micralyne Inc., which generated \$30 million in revenue from microsystems development and manufacturing last year. "There's more awareness in the marketplace of the possibility that microfluidics can solve problems."

Among those problems is the longstanding challenge faced by anyone required to take small amounts of medicine over an extended period of time, perhaps for a chronic condition like diabetes. Micralyne, one of just a handful of companies in the world dedicated to manufacturing microfluidic components, has been working with a Massachusetts-based company on a device that could assume this function, regularly sampling a patient's blood to determine the correct dosage and timing of a drug.

Inserted under the skin like a pacemaker, the heart of this tiny package will be a microfluidic chip from Micralyne, which could operate for as long as a year before requiring a new battery. Made from durable plastic, this implant could represent a cost-effective and potentially life-saving

solution for many people.

And there are even more of these solutions on the way, according to Chris Backhouse, a professor with the University of Alberta's Department of Electrical and Computer Engineering. He is part of a group of researchers at the university who have contributed to the steady progress of this industry since the early 1990s, regularly supplying ideas and talent to Micralyne over the years.

He and his colleagues recently created an analytical device about the size of a shoebox, which conducts intricate chemical analyses that were once only possible in a properly outfitted lab. Moreover, this system includes a port that can be connected directly to a computer, so the results can be displayed and recorded immediately.

According to Backhouse, the efficiency and portability of this device will simplify many essential health care procedures. For example, nurses could easily screen patients for adverse reactions to a new drug they have been prescribed. Similarly, during outbreaks of influenza or some other infectious diseases, hospital staff could readily sort out who should be sent home and who should be kept in quarantine.

Eventually, he notes, this technology should become much smaller than a shoebox, so small that one end would consist of the microfluidics array that carries out a test, while the other end could be inserted into a computer like a USB flash drive.

“We need to do in the life sciences what was done in consumer electronics,” he says, describing a pace of change that started with computing power that just a few decades ago needed a whole room full of machines, but now sits comfortably in an individual user's hand. “We can do this in a way that will save the health care system a lot of money, generate a lot of economic benefit, and establish Canada at the forefront of these new technologies.”

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Other Resources:

“A Chip against Cancer: Microfluidics Spots Circulating Tumor Cells”, *Scientific American*, April 2009

“Sony Shows Off Direct Methanol Fuel Cell Battery USB Charging Station”, <http://www.imicronews.com/lectureArticle.asp?id=2865>

“Introduction to microfluidics”, <http://www.chem.ualberta.ca/~harrison/Introduction.html>

Lab on a Chip, <http://www.rsc.org/publishing/journals/lc/>