



RESEARCH NEWS

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Providing a full-service 'micro-machine shop'

By Frank Nolan, Research Promotion Officer

If your research requires custom made micro-devices with features ranging from tens of nanometers to several microns in size, look no further than the Faculty of Engineering's Nano-Systems Fabrication Laboratory (NSFL). This state-of-the-art lab can fabricate everything from simple silicon wafers coated with a micron-thin layer of gold, to complex micro-machines or finely etched glass plates for DNA separations.

"This is a common-use university facility, and we encourage anyone who can make use of our services to do so," said NSFL director Cyrus Shafai, electrical and computer engineering. Shafai recently described the lab's capabilities to researchers at the Bannatyne Campus as part of the *This Lunch Hour Has 33 Minutes* lecture series. His sold-out presentation highlighted the wide range of high-precision devices the NSFL can produce.

"It's very much like a machine shop, only here we make very fine structures," he said. "What we make really depends on what you want to use it for."

The facility is completely self-contained, producing its own purified water on-site, as well as nitrogen gas for vacuum systems and for cleaning the materials used. The fabrication equipment is housed in a "clean room" that closely resembles a bio-safety lab, right down to the protective clothing

worn by the researchers. The major difference, Shafai said, is that while the clothing worn by personnel in a bio-safety lab is usually meant to protect the researchers, the gowns, hats and boots required in the NSFL clean room are designed to protect the equipment from any dust and dirt that people might bring in.

Fabrication in the lab involves three basic steps: coating, lithography and etching.

"It starts with the base material you want to use, which is then coated with whatever you need for your particular device," Shafai said. "Right now, the coatings we're working with are silicon and metals, including gold, titanium, chrome, copper, molybdenum and aluminum. This summer, we'll be adding new equipment to enable silicon dioxide, silicon nitride and spin-coated polymer coatings."

Once the material is coated, lithography is used to create the desired pattern and the unwanted parts are etched out using acid or gas.

"It's identical to the way computer chips are made," Shafai said. "Over the last 20 years or so, people began asking, 'why can't we do this to make mechanical parts?' That's how the whole area of micro-machines really developed."



Photo by Frank Nolan

NSFL director Cyrus Shafai demonstrates the lab's sputter system, which can apply coatings of metal as thin as a few nanometers.

Shafai is a member of the Nano-Systems Group that includes fellow electrical and computer engineering professors Doug Thomson, Greg Bridges, Derek Oliver and Doug Buchanan, who use the lab for their own research. The NSFL is currently hiring staff to provide training for any other university researchers who want to take advantage of the lab's capabilities.

The NSFL has already supported the research of 48 professors and students, including people from outside industry

and organizations, and researchers from different university faculties.

"We have chemists coming here because they need glass slides coated with gold", Shafai said. "Others need coatings they can pattern into complex structures, or they need to etch specific fluid channels. They can custom-make whatever it is they need for their own research, and they can save a lot of time and money by doing it right here on campus."

The financial implications of political uncertainty

By Frank Nolan, Research Promotion Officer

Researchers at the I.H. Asper School of Business have found that political uncertainty can have a significant effect on a company's market value.

In a recent study, Janet and Cameron Morrill, accounting and finance, found that firms headquartered in Quebec traded at an average of 12 per cent less than comparable firms based elsewhere in Canada. Their research was published last year in the *Journal of International Financial Management and Accounting*.

"What it comes down to is that the political uncertainty in Quebec appears to cause firms headquartered there to be perceived as a riskier investment," Janet said.

The project grew out of a discussion the Morrills had with Oregon State University professor Roger Graham, who worked with them on the research.

"Roger had seen a newspaper article that said the Quebec government had blocked a takeover of a Quebec firm by one from outside the province, and he was wondering if that kind of political climate might lower the value of companies located there," Janet said. "Having lived in Quebec, we understood political uncertainty, and even though it was outside of our current research, we

thought it was an interesting idea and began to look into it."

In addition to discovering that Quebec-based firms traded at a discount, they also found that the discount itself tended to vary over time.

"As political uncertainty becomes bigger, the gap tends to become wider," Cameron said. "For example, after the 1995 sovereignty referendum that was narrowly won by the federalist side, we found that the difference in value between Quebec firms and those headquartered elsewhere in Canada became much smaller."

After their paper was published, the Morrills began to investigate the implications of their findings from an accounting perspective. They thought that information about where a firm operates, such as where its sales occur, and where its facilities are located, might be relevant for firm valuation.

"Our first paper established that, at least in Canada where there are regions that have political uncertainty, it's relevant to know where a firm's headquarters are," Cameron said. "Our second paper considers where the operations are, particularly where the sales and employees are located.



Photo by Frank Nolan

Cameron Morrill and Janet Morrill, accounting and finance, are investigating the accounting implications of political uncertainty.

We wanted to know whether that information helps to understand how the market is valuing those firms."

Their second paper examined how specific geographic information about a firm's operations affected its stock market value. They compared the market valuation effects of assets and revenues of Quebec-based firms with those in the same industry that were located outside of Quebec. They found that firms with the highest activity in Quebec tended to be valued lower, even after taking

into account the location of corporate headquarters. The results imply that moving corporate headquarters out of Quebec, as many companies did in the late 1970's, might not be enough to insulate the firm's value from the effects of Quebec's political uncertainty.

In November, 2005, the second paper won the Vernon Zimmerman Best Paper Award at the 17th Annual Asian-Pacific Conference on International Accounting Issues.

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