CMC MICROSYSTEMS
IMPACT

All Charged Up

Novel sensors for safer and less costly maintenance of electrical power utilities

In countless open fields, wilderness corridors and remote areas across Canada, thousands of hydro utility towers and stations sit largely ignored by the many who benefit from their services. It may seem hard to get excited about stations, towers and lines–yet Dr. Cyrus Shafai, an Associate Professor in the Department of Electrical and Computer Engineering at the University of Manitoba, has generated a great deal of interest in a small device that measures electrical fields around these structures, with the goal of making them safer and easier to maintain.

Dr. Cyrus Shafai has developed a micromachined electric field mill (MEFM) to help alleviate the costs and portability issues involved in field mill installation maintenance.

All power lines and utility stations are surrounded by electric fields of varying strength and size. Measuring the strength of these electric fields is necessary to develop improved insulation systems for utility structures, to ensure personal safety during line maintenance, to identify faulty insulators, and to measure line voltage. Manitoba Hydro, one of the partners working with Dr. Shafai, is particularly interested in measuring atmospheric electric field strength near high-voltage, direct current (HVDC) electric power transmission lines as a way to predict flashover hazards.

Although various instruments exist to measure these electric fields, most are bulky and require frequent maintenance, which can be particularly difficult and expensive in remote locations. Dr. Shafai, working jointly with colleagues at the University of Manitoba, Manitoba Hydro and the Manitoba HVDC Research Centre, has developed a micromachined electric field mill (MEFM), a measurement tool that's able to provide the same diagnostics as current tools, but in a miniaturized package that's both highly portable and less costly to use. "The device solves many issues, including the need to make costly trips to maintain field mill installations," he says.

Key elements of the novel MEFM include the use of thermal actuators which in turn allows use of smaller drive signals, improving the accuracy of the measurements; and use of lever mechanisms to amplify the displacement produced by the thermal actuators. The sensor has a linear response to a wide range of electric fields, and the sensor signal processing is completely electrical. Therefore, the sensing system can be designed to be very compact and can be used in various applications.

Dr. Shafai notes that CMC provides valuable resources for this technology. "CMC fabricates our MEFM devices and also provides important packaging services, along with design and modeling software," he says. "I've been working with the organization for over 11 years–their services are vital to the success of my work."

Along with his work on the MEFM project, Dr. Shafai's current collaborations include odour sensors for detecting spoilage in stored grains and identifying the source; MEMS for microstrip phase shifters and frequency agile antenna, tunable microwave filters, and adaptive surfaces; microfluidic thermal cooling; and most recently, separation membranes for immune cell research. Dr. Shafai undertakes his research at the Nano-Systems Fabrication Laboratory at the University of Manitoba, an open-access cleanroom facility that offers the necessary multi-disciplinary environment for these types of discoveries. The facility has been used by over 100 researchers, including several from other universities.

"Working with organizations such as CMC and with other researchers provides opportunities for collaboration in unique ways," he says. "It is how we foster new ideas and create solutions and tools for today and for our future." *cmc*