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News from the Canadian Light Source Business Team

# INNOVISION



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## Scientists are "Real People"

The Canadian Light Source (CLS), as Canada's newest big science project, has a strong working relationship with 39 Canadian universities and their synchrotron scientists. We are also building a solid reputation with different industry sectors, including mining, oil and gas, agriculture, pharmaceuticals, medical imaging, aerospace, automotive, and medical device manufacturers.

Along with academic and industrial outreach, our science education outreach to schools has grown dramatically in the past year and is now truly national in scope. The two key educational programs are a summer school for science teachers and beamline science projects for high school students, awarded through a competitive process. During the year, we also make presentations at science teacher conferences to increase awareness. We are doing our part to help develop the next generation of scientist and, quite possibly, a Nobel Laureate or two.

I must commend NSERC and its PromoScience Program, without which our national program would not have been possible.

I am hopeful that our corporate and academic partners will also recognize the importance of this effort to increase

interest in science within our schools. It will help ensure a supply of highly qualified personnel to meet future needs for maintaining and growing business, and provide the academic scientists needed to keep our universities world-class.

A few quotes from the teachers and students truly summarize the benefits of our efforts:

*"...the experience inspired me, as now I have developed the habit of taking data even of the smallest of things..."*

*"The project did not just foster knowledge about the synchrotron, electron orbitals and honey, but many other practical skills that are needed in all fields of study and concerns such as decision-making, preparation, time management and focus."*

*"This experience taught me the real scientific method, not like the ones we discuss in school when you know the answer before you start."*

*"...scientists become real people which make the students realize this scientific research might be an option for their future..."*

As you can see from these comments, we have made science exciting for the students involved with CLS, and who might just be your future employees.

I trust you enjoy this "Back to School" issue of *InnoVision*. Like the students, I hope it inspires you to look at the Canadian Light Source as a resource for your research and business.

*"The greatest discovery of any generation is that a human being can alter their life by altering their attitude."*

– William James

Murray McLaughlin  
CLS Director of Business Development





## INDUSTRIAL PARTNER

"We could only postulate how the contaminants were associated with adjacent elements. Now we can answer that question."

## Cameco: Collaborating for the World's Uranium Future



Certain chemical elements in uranium mine tailings pose a potential risk to the environment, so much so that the Canadian Nuclear Safety Commission requires that potential impact be modeled for up to 10,000 years. In order to improve these estimates, Cameco and University of Saskatchewan researchers like Jim Hendry are, he says, "using almost all available analytical techniques to assess the fate and transport of potential contaminants from the tailings."

The demanding nature of this effort has led Cameco to join forces with the University of Saskatchewan and the CLS, bringing researchers and industry together to study the long-term fate of these mining by-products in the environment. "From the corporate side, this is a really good thing to do," says Tom Kotzer, Cameco's senior environmental

geochemist. "We gain access to researchers and technologies that we wouldn't normally have on a daily basis."

Hendry, an NSERC Industrial Research Chair in Geological Sciences, leads the research to examine the behaviour of arsenic, radium, and other elements in the mine tailings and surrounding groundwater flow system. These elements and associated complexes may be solid or liquid. The NSERC-funded researchers want to see how long they will remain in their solid form once the toothpaste-like tailings have been deposited in the tailings facility. The challenge is predicting when the elements will, over the next 10,000 years, leach into the surrounding natural rock, and flow with groundwater to arrive in nearby lakes and streams.

Only the high-energy beamlines at synchrotrons such as the CLS have proven sensitive enough to characterize these elements present at small

concentrations in a poorly crystalline matrix. When in solid form, arsenic and other elements are bound to other minerals, effectively tying them up in the tailings. "Understanding the binding is impossible without the synchrotron," says Hendry. "Before we used it, we could only postulate how the contaminants were associated with adjacent elements. Now we can begin to answer that question."

Given the immense time scale and possibility for unexpected change, the researchers' aim is to narrow the range of possibilities. "The goal is to reduce uncertainty," says Kotzer. "We can't always reasonably predict what will definitely happen 10,000 years from now, but we can use these data and concepts to improve our understanding, hypotheses and modeling results." Publishing this information will help, Hendry says. "It's the peer review process that ensures the integrity of the science."

What also helps solidify the science is the collaboration itself: the merging of Cameco's expertise in engineering, metallurgy, and geology with the University's knowledge in aqueous and environmental geochemistry, and the unique synchrotron analytical techniques available at CLS. The arrangement also provides data that would be otherwise unavailable to academics. "Being a university researcher working with industry on highly scientific, highly industrial research," says Hendry, "is highly rewarding."

*Tom Kotzer, Cameco Senior Environmental Geochemist and Jim Hendry, Senior Cameco-NSERC Industrial Research Chair, Geological Sciences, University of Saskatchewan*





## INDUSTRIAL PARTNER

"The measurements that we have made could only be done at the CLS and have been very useful in helping us optimize the performance of our instrument."

## Synodon and CLS Partner in Remote Sensing of Natural Gas Leaks



Developing highly efficient detection systems for natural gas pipeline leaks is not just cost effective, it also saves lives. The CLS has been working closely with Synodon Inc. to create new, more effective ways of monitoring natural gas pipelines.

The traditional method of detecting a leak in natural gas pipelines is to have workers walk the length of the line with hand-held sensors. This method is both slow and inefficient, as it cannot detect leaks until they are quite large.

Doug Miller, Chief Technology Officer at Synodon Inc., is developing an airborne natural gas pipeline leak detection system called realSens™ that will be the most advanced in the world. Synodon adapted an existing methane monitoring technology, known as Gas Filter Correlation Radiometry (GFCR) to detect upwellings of natural gas in the lower atmosphere.

The new technology, known as Simultaneous View Correlation Radiometry (SVCR) is able to detect specific properties of natural gas, ensuring that other emissions that occur naturally do not affect the sensors.

Besides being more accurate in its detection, realSens™ is far more efficient. It has been designed

as an infrared optical instrument that is attached to a helicopter. The helicopter can fly over 100 km of pipeline in an hour to detect leaks and identify defects in the pipeline far earlier than with traditional hand-held detectors.

Early detection is critical to the safety of pipeline workers and the public. Miller explains, "In high-pressure gas pipelines, which bring the gas from the fields to the distribution points, a small leak can become a large leak in a hurry. Occasionally, there are catastrophic accidents that result in major property damage and loss of life."

The CLS is being used to improve the quality of realSens™. The synchrotron's far-infrared beamline conducts spectroscopic analyses of gases, the results of which go into refining Synodon's technology. These methods of analysis are unique to the CLS.

"Synodon is very pleased to be able to utilize the leading edge CLS facility," says Miller. "The measurements that we have made

could only be done at the CLS and have been very useful in helping us optimize the performance of our instrument."

There is huge potential for the technology used in realSens™ to extend to other applications. It could be used in the remote sensing of other gases, and as part of other airborne or satellite-based remote sensing solutions. The possibilities are endless!

Doug Miller,  
Chief Technology Officer,  
Synodon Inc.

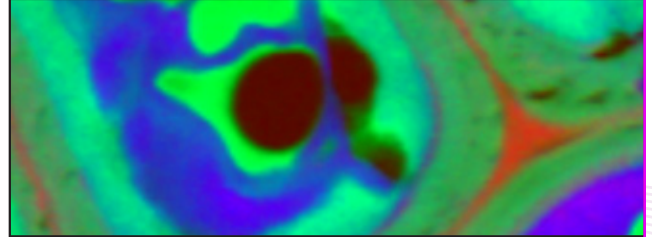




## BEAMLINE PROFILE

The spectromicroscopy beamline is one of a kind in the world; capable of revealing phosphorus and sulphur, important elements in biological systems at the nanoscale.

## Spectromicroscopy Beamline: Revealing the Workings of Technology and Life



At the otherworldly scale of a billionth of a metre, it is typically difficult to study matter, especially anything biological. Yet X-ray spectromicroscopy is illuminating materials at the nanoscale, potentially leading to everything from better environmental remediation to advanced computer technology.

The broad applications of the X-ray spectromicroscopy beamline range across materials manufacturing, environmental and biological research, and exceed the power of conventional methods. While electron microscopy only reveals the structural makeup of a manufactured or biological material, this beamline reveals the structural makeup in association with chemical components in the sample. It even shows the three-dimensional structure and composition of something as intricate as a biological cell.

“It’s important to understand the functional properties to know how chemical information is associated with structure,” explains beamline scientist Chithra Karunakaran. “For example, in cell biology, you can locate the cell’s nucleus or cell wall, and say what it’s composed of.”

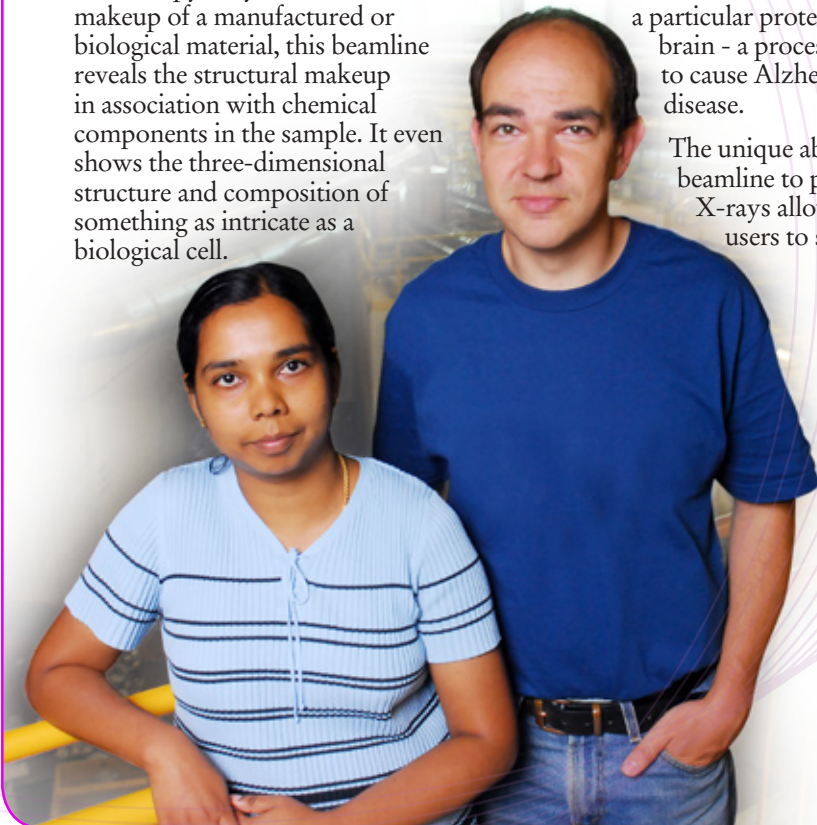
The spectromicroscopy beamline is one of a kind in the world; capable of revealing phosphorus and sulphur, important elements in biological systems at the nanoscale. Researchers are currently using the beamline to test for the presence of sulphur in brain matter. The element alters a particular protein in the brain - a process believed to cause Alzheimer’s disease.

The unique ability of the beamline to polarize X-rays allows its users to study the

orientation of molecules. In their quest to create materials as tough as spider silk, researchers are using the tool to examine the proteins that give the spider silk its unmatched strength and the effect hydration may have on it. Its polarizing property also allows users to study liquid crystals and magnetic materials, a phenomenon that could lead to better computer displays and faster, more compact memory. Other materials under examination at the beamline are carbon nanotubes, a microtechnology with a range of potential applications, from clothing to space elevators.

The beamline’s scanning transmission (soft) X-ray microscope (STXM) examines bulk and wet samples, making it ideal for both biological and environmental studies. A second microscope, the Canadian Photoelectron emission Research Spectromicroscope (CaPeRS) requires flat, conductive, high vacuum compatible samples and is a surface sensitive technique. In STXM, microorganisms associated with river water and food products have been examined. “We can study the biological materials in their native forms, when they are wet,” Karunakaran says. “This gives us the capability to understand the mechanism of how they can play a role in bioremediation or control.”

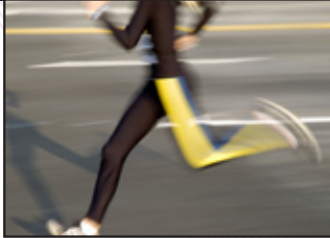
*Chithra Karunakaran, SM Beamline Scientist and  
Martin Obst, SM Post Doctoral Fellow (McMaster  
University)*





## CUSTOMER PROFILE

“We have conducted a series of tests, and we plan to continue testing to ensure quality control, such as shelf-life and other aspects.”



## Startup Company Shuts Out Bacteria in Sports

Two athletes with business degrees are improving the lives of pro and amateur athletes through their new athletic cleaning solutions—and the CLS has helped get their product launched.

Chad Fischl, co-founder of Shutout Solutions, says, “My business partner, Dan Robinson, and I have played sports all our lives. We were aware that there are no cleaning products that really work, and Dan was extremely sensitive to harsh chemicals. We decided to try to make a product that worked and which was as natural as possible.”

In their research of ingredients that would help their product meet their goals, “we stumbled across nano-silver as a potential key ingredient. We also spoke with the (CLS) synchrotron about the potential of

working with them to get our product off the ground.”

Their research led them to a company overseas that had patented the specific form of nano-silver that would work best for their application. They have since worked with this partner to create the product they envisioned, eliminating chemicals and replacing them with such natural ingredients as *Camellia sinensis*, *Ginkgo biloba* and D-limonene, a derivative of citrus oils. The detergent works just as effectively in cold water because silver does not need heat to activate and kill bacteria. This will reduce the need for harsh chemical disinfectants, extend the life of washed items, and save a significant amount of energy, since 90 percent of the energy spent in washing clothes is used to heat water.

The first sample products that Shutout received from their supplier were tested on the CLS Hard X-ray MicroAnalysis (HXMA) beamline to confirm the quality of the

nano-silver. Jeff Warner, CLS Industry Liaison Scientist, explains, “The work we are doing for Shutout centres around quality control and quality assurance. The active ingredient can exist in different chemical forms. The synchrotron can identify these forms and provide information on relative ratios and chemical speciation. We can also study their product both before and after its use to spot changes and measure efficacy.”

Fischl is excited about developing an ongoing relationship with the CLS.

“We have conducted a series of tests, and we plan to continue testing to ensure quality control, such as shelf-life and other aspects.”

“We look forward to working with Shutout,” confirms Warner. “We believe we can provide cradle-to-grave, value-added information, from product characterization to details on its efficacy during use and information on the environmental end product. We welcome working with a company that is concerned with all aspects of its product’s development, use and disposal.”

While Shutout and the CLS are focusing on big ideas like ‘cradle to grave’ production, the users of Shutout’s athletic cleaning solutions will be enjoying improved bacteria and odour control in their athletic gear—and the list of devoted customers will keep growing.



Chad Fischl and Dan Robinson



TRACY WALKER

"We're connecting high school students with scientists doing cutting-edge research."

## SYNCHROTRON U: *Building science capacity in Canada... One classroom at a time.*

Hands-on experiences are one of the best ways for students to learn. Traditional school-science experiments expose students to the motions of the scientific process with 'cook book' experiments and expected outcomes that sometimes aren't relevant to today's cutting-edge science. Getting more of today's youth hooked on science means exposing them to the newest scientific tools and techniques.

Enter Tracy Walker, CLS Education Outreach Coordinator and graduate student in Curriculum Studies, and the CLS Students on the Beamlines program.

"Students on the Beamlines is designed to allow students to experience the breadth of the research process, from posing a question, to designing an experiment, collecting data, and explaining the results," says Walker. "We're connecting high school students with scientists doing cutting-edge research."

The program started in 2006, with a collaboration between Walker, CLS staff scientists and a Saskatoon physics teacher. The result was a staff-developed experiment, using soft X-rays to analyze soil samples collected by the students. A class from a rural Saskatchewan school repeated the experiment later, with their own samples.

The studies were the first of their kind and helped to spawn a new area of study in soil science.

Walker points to the success of the soil study as one of the added benefits of doing synchrotron research with high school students. "The

kids are able to open up whole new areas of research by designing simple experiments that professional scientists might not do," she says.

Walker cites a recent experiment conducted by a group of students from Lloydminster, Alberta who used one of the beamlines to analyze the composition of honey from different flowers. Not only was it the first time that honey was examined using a synchrotron, but the students also found carbon monoxide in one of the samples – the first time the gas had been detected on that beamline. "I've got researchers from across the country coming to me and offering to work with classes – that's really exciting."

With funding from a PromoScience grant from the Natural Science and Engineering Research Council, Students on the Beamlines now has a national reach. The centerpiece of the program is a competition, with students submitting proposals to conduct an experiment at CLS. The grant also makes it possible for students from across Canada to participate: students from Liverpool, Nova Scotia, analyzed the structure of meteorites with scientists from the Universities of Alberta and Saskatchewan.

"The students think, from their school labs, that their teacher or the researchers they are working with will be able to explain their results," says Walker. "What always catches them by surprise is that the answers to the experiment aren't known, because no one has seen what they're looking at before. That realization – that experience – is what I want this program to give them."

*Tracy Walker,  
CLS Educational  
Outreach  
Coordinator*

