PROFILE

Educator puts profession in positive light

By Michael Mastromatteo

A highly acclaimed University of Toronto engineer continues to break ground in harvesting light for dramatic new applications. The accolades say a great deal about the team leader, but for engineer Ted Sargent, it's more a case of using all the available talent to transform physics into function.

A recent cover of an information technology magazine features a striking photo of Canadian engineer Ted Sargent staring into the distance in arms-folded determination. Looking very much like Toronto Maple Leafs captain Mats Sundin (only with an iron ring), the subject of the photo exudes an unmistakable sense of confidence, casualness and youthful vigour.

The name Ted Sargent has been cropping up often in engineering and research journals, trade publications and the mainstream media. Although his teaching and groundbreaking research are attracting most of the attention, there's no doubt the entire Sargent "persona" helps keep him in the spotlight.

Sargent, in fact, is no stranger to accolades or media attention. In 2004, he was named one of Canada's "Top 40 Under 40" achievers by The Caldwell Partners, the largest executive search firm in Canada, and featured in *The Globe and Mail Report on Business* magazine. The previous year, MIT's *Technology Review* selected Sargent "one of the world's top young innovators."

What's he been doing to earn all the fuss? In essence, Sargent is combining elements of nanotechnology with engineering physics to manipulate light for fascinating new uses in communications, energy, medicine and a host of yet-to-be-determined applications.

The bulk of his work falls into two main categories. The first involves research into emerging optical networking technology, particularly the use of "quantum dots" embedded in a semiconducting plastic material that can produce light at wavelengths suitable for enhanced fiber-optic communication. The ultimate objective of such work is to enhance Internet communications so that not just the heart of the network itself, but individual users, can transmit data using light's blazing speed and vast capacity to carry information. The work addresses the lingering problem of limitations in existing data transmission architecture hindering the increasing complexity and volume of today's network communications.

The Canada Foundation for Innovation suggests that Sargent's efforts to manipulate light for use as a channel of vast amounts of information are akin to turning science fiction into reality.

The second–and related–area of Sargent's research deals with processes to exploit infrared light, which could have enormous implications for the use of solar energy. By embedding nano-sized materials into various substances, including paints, inks, fabrics, plastics and road surfaces, currently unusable elements of sunlight can be put to use collecting and storing energy. Sargent has described this work as "harvesting" the currently unused spectrum of sunlight.

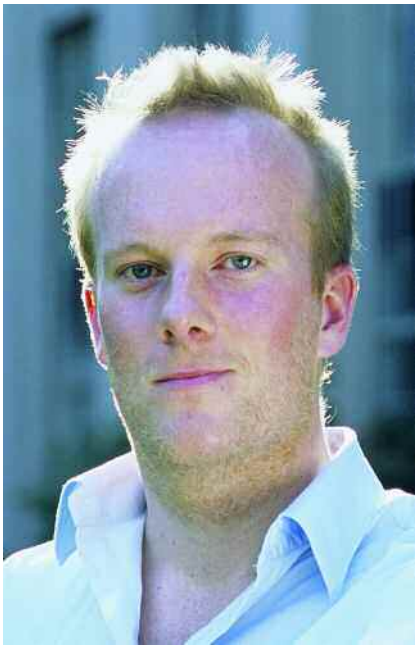
"Our work applies quantum dots–nanometer-sized particles–active at infrared wavelengths," Sargent recently told *Engineering Dimensions*. "In the past year, we have shown that our novel materials system and the resultant devices can bring substantial benefits to the energy sector, prospectively allowing cheap, efficient harvesting of the sun's energy." The same work can also advance a technology to allow early cancer detection using infrared light. The research also has an impact on the communication and networking field by, as Sargent points out, "advancing a platform technology with which to integrate electronic, optical and wireless communications."

Back at U of T

Sargent recently completed a term as visiting professor in nanotechnology and photonics at MIT in Cambridge, Massachusetts. In July 2005, he returned to the University of Toronto (U of T) to resume full-time teaching and research at the university's department of electrical and computer engineering. He is the Nortel Networks-Canada Research Chair in Emerging Technologies at U of T's Edward S. Rogers Sr. department of electrical and computer engineering.

An Ottawa, Ontario native, Sargent graduated with a bachelor of science in engineering degree from Queen's University in 1995. He earned a PhD in electrical and computer engineering from U of T in 1998 and immediately joined the department's faculty. He was licensed by PEO in 2004.

Sargent credits a high-school physics instructor, Brian Harris, for sparking his interest in design-oriented physics problems. Engineering professors at Queen's furthered this active interest in exploiting the problem-solving capabilities of scientists and engineers. This, in turn, inspired Sargent's emphasis on "inverse problem" questions, especially



Photos: Jared Leeds

in terms of the potential inherent in nanotechnology.

"The passion that engineering–in particular, engineering physics–developed in me was for turning physics into function," he said. "Our passion for building materials from the molecule up is an example of this, one enabled by the very latest advances in materials chemistry. The focus on the inverse problem–starting from the human need and then using our function-structure understanding to design matter from the molecule up–is the classical ethos of engineering, deployed in areas of rapid and exciting progress in science."

As a staunch proponent of the engineering profession's obligation to communicate its achievements, Sargent misses few opportunities to discuss and celebrate his team's research efforts. In fact, he adds "communicator" to the string of nouns to describe his occupation. "I would say that I'm an engineer, researcher, educator and communicator. I would not prioritize one over the other. To me, it is the fact of being all these at once that makes my work challenging, exciting and satisfying."

Effective communication is a hallmark of Sargent's written work. Fond of metaphor and an adroit turn of phrase, Sargent brings prose elegance to technical subjects. In one published article, for example, he described nanotechnologists as "choreographers [who], by coordinating the dance among atoms and molecules, seek to realize a broader vision: a new material, an ultra-fast computer chip, a new medical diagnosis which warns of disease before symptoms appear." The same article describes nanotechnologists as "harmonizing within nature's own set of rules to coax matter into new forms."

Sharing the glory

Dr. Anastasios (Tas) Venetsanopoulos, P.Eng., U of T dean of applied science and engineering, says that despite Sargent's lengthy list of achievements, he strives to share his success with research assistants, colleagues and students.

"There's no doubt that he has brought a lot of acclaim to the university, but he is always quick to share the glory," Professor Venetsanopoulos said. "He also has a tendency to attract very talented people to work with him and that, in turn, becomes an asset, because Ted is the first to tell you that he couldn't have accomplished all these breakthroughs on his own."

Venetsanopoulos also describes Sargent as "a Renaissance kind of scientist" for his abilities to immerse himself in all aspects of a problem and avail himself of a full spectrum of disciplines, before aiming for a solution.

Professor Jonathan Rose, P.Eng., chair of U of T's electrical and computer engineering department, says that in many ways, Sargent's approach to problem solving speaks to the heart of an engineer's calling.

"Ted's drive and enthusiasm and his interest in seeking innovation can be seen as the best examples of what engineers and engineering research are all about," Rose told *Engineering Dimensions*.

There is no doubt that Sargent emphasizes the convergence of science and engineering as a key element in innovation and technological breakthrough. He also draws inspiration from the uniting of physics, chemistry and engineering in service of the public good. "To me, pursuing the PEO licence was an integral part of this convergence of convictions and disciplines," Sargent said.

Given the success of the recent past, and the potential his work holds for the future, Sargent approaches the future with a bold sense of optimism. "We continue to benefit from outstanding support from federal and provincial funding agencies and from the University of Toronto, and our relationships with Canadian industry deepen further, helping us to set the bar high for ourselves in relevance and impact."

And despite his collaborative approach to his research, Sargent continues to hold a special place for the engineering contribution. "Engineers at the frontiers of science and technology hold the same responsibilities to society as do those engineers who create based on more matured scientific principles," he says. "They have a distinctive perspective on the ways in which new discoveries can be applied for good or for ill. They are responsible for communicating this sense of potential to students, colleagues, policymakers and citizens."

For more on the latest research in nanotechnology, Ted Sargent's new book, *The Dance of Molecules: How Technology is Changing Our Lives* (Penguin), will be available in bookstores on October 8, 2005. Visit www.tedsargent.com or www.penguin.ca.