

National Research
Council Canada

iCORE



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\$10 million research program taking radical departure to realize functional nanotechnology devices

Edmonton...A remarkable Canadian researcher has come to Alberta to head up a \$10 million research program that aims to develop functional nanotechnology devices.

"Alberta welcomes Dr. Wolkow and other talented researchers looking to relocate to the province," said Victor Doerksen, Minister of Alberta Innovation and Science. "Research is the key to developing new ideas and discoveries that can lead to innovation. The ultimate benefit from these ideas and discoveries is when they are translated into new and improved products or services for enhancing the quality of our lives."

Dr. Robert Wolkow has moved from Ottawa where he was Leader of the Molecular Interfaces Program of the National Research Council's (NRC) Steacie Institute for Molecular Sciences, to take up a five-year term as iCORE Chair of Nanoscale Information and Communication Technologies. This program is jointly funded by the Alberta Informatics Circle of Research Excellence (iCORE), the University of Alberta and the National Institute for Nanotechnology (NINT) of the NRC headquartered in Edmonton.

"A key driving force behind my move here is to find broad thinking and stimulating collaborators who will help explore an altogether new roadmap for understanding and fabricating molecular-scale devices," Dr. Wolkow explains. "Together, the University of Alberta and NINT have the potential to provide an environment for collaboration that is, in my view, unrivalled in Canada and equal to any in the world."

Dr. Wolkow was one of the youngest scientists invited to join the Royal Society of Canada, when he became a Fellow in 2002 at age 42. He has a string of achievement awards from every institution he has joined and is now committed to building on the opportunity emerging in Alberta, catalyzing a world-renowned research cluster in nanoscale science and technology.

"Alberta offers the ideal environment - a pioneering spirit, support for risk-taking, a commitment to excellence, and a world class vision - for scientists like Dr. Wolkow," says iCORE President and CEO Brian Unger.

University of Alberta president Rod Fraser says this appointment will have a dramatic effect on the momentum that surrounds an already excellent research program. "We can expect to see the university's reputation in nanoscale research multiply and expand with Dr. Wolkow's addition to the faculty, helping to foster a burgeoning interdisciplinary community."

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NOTE to EDITORS: a backgrounder attached.

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Background

Dr. Robert Wolkow

Research Program Overview

Dr. Robert Wolkow is leading a \$10 million research program called Nanoscale Information and Communication Technologies, through his appointment as an iCORE Chair, affiliated with the Department of Physics at the University of Alberta and the National Research Council's National Institute for Nanotechnology. The main goal is to explore fundamental concepts for molecular computational building blocks.

This research team is taking a radical departure from convention, shaped by a belief that new nanoscale-level understanding of and control over matter is ripe for revolutionary developments. Even from a conservative standpoint, Wolkow says that it now appears reasonable to bet that powerful new capabilities will emerge from control over the nanoscale. Wolkow's team will work in the scientific discipline at the center of this new capability - chemical physics - the study of molecules with the tools and mindset of the physicist and with the aim of understanding, controlling, and harnessing molecules as structural and active components.

The challenges for the team are significant. The potential to create a new technology is one thing, but a working device, even a primitive prototype is quite another. Wolkow plans to work on a host of coordinated, forefront research activities that feed into a logical path and rationale that leads research forward toward working prototypes.

Dr. Wolkow has pondered molecules as devices for 15 years, and offers the following introduction to the thinking behind his research program based in Alberta:

- We know that molecules can achieve computational feats beyond the ability of any computer made by people. For example, our brains allow us to easily recognize a face and even the gender, age and mood of a person after just a glance while no computer can come close to that capability. Many other examples can be cited. So the question isn't, can molecules perform computations? The question is, how do we fit a harness onto molecules and put them to work?
- To be practical, functional nanostructured systems will need to be largely self assembled.
- Discriminating mating interactions between molecular groups can be designed - a capacity not shared by our familiar semiconductor systems - and one that suggests we can design self-assembling molecular systems.
- Molecules can be thought of as prefabricated units that come with predetermined and unique size, shape, flexibility, chemical and physical affinities, electronic spectra, thermal conductivity, and more. Because we have the potential to put into place in one step a complex functional unit, we may be able to drastically reduce the number of processing steps, and therefore the cost of making devices.

It is clear that in order to achieve competitive computational capacity - whether aimed at rational decision making (AI) or massive mathematical calculations - we will need systems of very substantial complexity.

Research Program Funding

To develop the research program, Dr. Wolkow has received an iCORE Chair and Professor Establishment (CPE) grant of \$750,000 per year for five years, for a total of \$3.75 million. This represents roughly 39% of the total \$10 million budget. The National Institute for Nanotechnology of the NRC will support the

research by creating a new Nanoscale Devices group which Dr. Wolkow will lead. NINT will commit up to \$4.5 million over five years to support research and facilities development for this program. The University of Alberta is contributing \$350,000 per year for a total of \$1.75 million.

Biographical Information

Dr. Robert A Wolkow has been recruited to Alberta from Ottawa, where he was leader of the Molecular Interfaces Program of the NRC's Steacie Institute for Molecular Sciences. He received his BSc Honours in applied chemistry from the University of Waterloo in 1982 and PhD in chemistry from the University of Toronto in 1987. After graduation he worked as a postdoctoral fellow at IBM where, beginning with an empty room, he built-up a lab and showed, for the first time, that scanning tunneling microscopy (STM) was a uniquely powerful tool for the study of chemical processes. This study initiated the new field of atom-scale surface chemistry. He then moved on to become a member of the technical staff at AT&T Bell Laboratories, where he tackled technical challenges that were widely thought to be insurmountable, and developed the first variable temperature cryogenic STM. He joined the Steacie Institute in 1994 as a senior research officer, and produced four key research results in the first two years, all relating to first-time ever views of the dynamics of molecules on surfaces. These are key to understanding and fabricating nanoscale devices. More recently, he achieved a breakthrough in the understanding of the early stages of molecule-surface interactions, which was published in the journal *Science*. Another significant development was reported recently in the journal *Nature*, which has helped make the tools of the surface physicist relevant and accessible to chemists.

Wolkow became principle research officer at the Steacie Institute in 2000 and leader of the molecular interfaces program the following year. During his time at the Institute, he was also adjunct professor of chemistry at the University of Ottawa and adjunct professor of physics at McGill University. He became a member of Canadian Institute for Advanced Research nanoelectronics program in 2002.

He has received awards for outstanding achievement from almost every institution he has worked, including the T.J. Watson IBM Outstanding Achievement Award, Steacie Institute for Molecular Sciences Outstanding Achievement Award, National Research Council of Canada Outstanding Achievement Award, Royal Society of Canada Rutherford Memorial Medal, and the Noranda Award of the Canadian Society for Chemistry. He became a fellow of the Academy of Science of the Royal Society of Canada in 2000.

Wolkow has played an active role on many conference and other event organizing committees, and maintains a strong focus on the development of future researchers through support for students and postdoctoral fellows. He also works to increase science awareness and education and has worked extensively with media to make nanotechnology accessible to lay audiences.

Research Team

In addition to Dr. Wolkow, the immediate research team will include three research associates, three postdoctoral fellows, three graduate students, admin, two technicians, and a machinist. Dr. Wolkow is planning to foster a rich collaborative and cross-disciplinary environment which enables not only his team but related teams that form as appropriate to attack key problems across disciplines - in medicine, physics, chemistry, engineering - with vigour and excellence. He currently has active partnerships with theorists in London and Liverpool, as well as Taiwan, with whom he is exploring new methods for nanostructure fabrication.

For more information, contact Dr. Bob Wolkow at bob.wolkow@nrc.ca.

About iCORE

The mission of the Alberta Informatics Circle of Research Excellence (iCORE) is to attract and grow a critical mass of exceptional researchers in the field of informatics, that is, areas of computer science, electrical and computer engineering, physics, mathematics and other disciplines related to information and communications technology (ICT). iCORE was established in October 1999 by the Government of Alberta

to foster world-class university-based research that supports the ICT sector. This investment stems from a belief that strong fundamental research is at the core of a healthy economic sector, and that ICT research warrants special attention as an engine for innovation. This in turn creates social, cultural and economic advantages for Albertans.

For more information, visit www.icore.ca.

About the National Institute for Nanotechnology

The National Institute for Nanotechnology is an integrated, multidisciplinary research institution involving researchers in physics, chemistry, engineering, biology, informatics, pharmacy and medicine. Funded and operated through a partnership of the National Research Council of Canada, the Government of Alberta and the University of Alberta, it will carry out advanced research and innovation in support of a new generation of nanotechnology-based firms.

Located on the University of Alberta campus in Edmonton, the Institute's upcoming 15,000 square-metre facility is designed to accommodate 120 permanent staff; up to 45 guest workers from industry and universities; and training opportunities for some 275 graduate and post-doctoral researchers.

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