The Nano-systems Fabrication Laboratory at the University of Manitoba

What is Nanotechnology and Nanosystems?

Nanotechnology

- Nanotechnology is the creation of functional materials, devices, and systems through control of matter on the nanometer (1 to 100+ nm) length scale and the exploitation of novel properties and phenomena developed at that scale.

Nanosystems (NST's)

- NST's include microelectronics, micro-fluidics, micro-electro-mechanical systems (MEMS), and photonics. Several technologies are often combined on a single nanosystem device, enabling the production of powerful devices with high productivity.
- Nanosystems technologies (NST's) are making possible the manufacture of complex systems which possess the benefits of high integration of multi-disciplinary technologies, along with the benefits of low cost and small size.
- NST's are increasingly underpinning applications across diverse industrial sectors, including telecommunications, healthcare, biotechnology, pharmaceuticals, automotive, aerospace, agriculture, consumer electronics, and the environment.
- Microsystem devices are already greatly impacting our lives, and over the next decades, NST's will impact our world as much as microelectronics has done over the last 30 years.

Why Does Nanotechnology Matter?

- Nanotechnology has been identified as a strategic area by governments and industry worldwide. It is estimated that the annual industrial production in this sector will exceed $1 trillion US by 2015.[1]
- The investment by government organizations in 2003 was over $2.5 billion US. [2]
- The growth of microsystems in diverse industrial sectors is projected to be many times faster than Canadian GDP. Some forecasts for microsystems include:
    - In the automotive sector, Electronics as percentage of total automobile price was 20% in 2003, and is projected to reach 35% by 2010.[3]

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[1] US National Science Foundation (NSF), 30 June 2003.
[2] European Commission, 2003.
[3] Emerging IC Markets, 2004 Edition: A Study of Future Market Opportunities for Integrated Circuits", IC Insights, 2004.

- In the healthcare sector, the market for biochips, estimated at $2 billion US in 2004, is projected to exceed $7 billion US by 2008.[4]
- Growth in information and communications technologies (ICT), a sector built on microsystems, was at an annual rate of 7.6% from 1993 to 2001.[5]

What is the Nano-Systems Fabrication Laboratory?

- The Nano-Systems Fabrication Laboratory (NSF lab) at the University of Manitoba (U of M) was established to support the nanotechnology efforts of Canadian researchers and industry. It is the only facility in Manitoba, and one of only a handful in Canada, capable of micro/nano-scale manufacturing. The NSF lab offers strategic support to Manitoba and Canadian researchers and industry.
- The NSF lab is two years old and houses over $7 million in nano-systems fabrication infrastructure. The Lab provides a comprehensive nanosystems fabrication capability that can meet the needs of researchers and industry.
- The NSF lab is a central facility at the U of M, and as such links multidisciplinary researchers. Its nanosystem prototyping and testing ability facilitates and expands the collaboration between researchers and industry for pre-competitive prototyping development.

What is the Lab's Industrial Collaboration Track Record?

- During it first two years of operation, three very successful microsystem projects have been undertaken at the NSF lab with industrial partners, resulting in the filing of two patents.
- Two projects with InfoMagnetics Technologies have lead to the development of new innovative microsystems for wireless telecommunications. These projects were conducted in collaboration with the Canadian Space Agency, and the Communication Research Centre. The devices developed at the NSF lab are a Micromachined Frequency Agile Antenna and a Micro-Membrane Microstrip Phase Shifter. These devices are technology demonstrations for a new generation of antenna systems, which will be capable of adapting themselves to terrain, urban effects, weather, and directional requirements.
- A project with Manitoba Hydro has lead to the development of a miniature Electric Field Sensor. This device was developed to help Manitoba Hydro, and other electric utilities worldwide, with the problem of measuring atmospheric ionization around power lines. High electric fields can lead to high voltage arc discharges. Such discharges are a serious risk to worker safety and affect system reliability. The device developed at the NSF lab can measure electric fields smaller than 0.5 V/m, an improvement of over 1500 times the prior best achieved by a micromachined device at Berkley University. A patent is currently under investigation.

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[4] Overview of the Canadian Pharma/Biotech Needs for Microelectronics", Canadian Microelectronic Corporation (CMC), 2003.

[5] World Information Technology and Services Alliance (WITSA), 2002.