

Overview of Canada and Québec Nanotechnology Initiatives

3rd Annual Arizona Nanotechnology Cluster Symposium

Prof. Normand Voyer

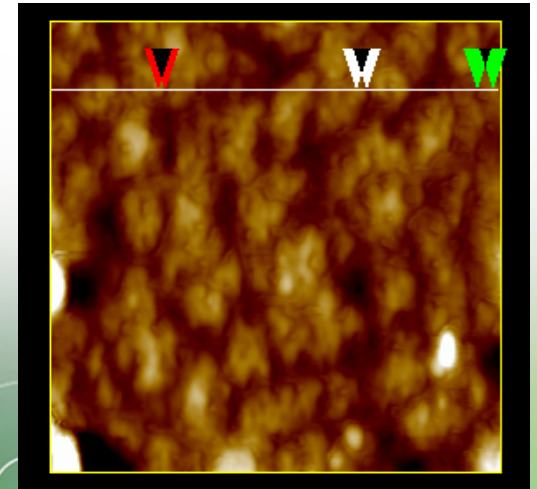
Nano⁴Laval

Université Laval, Quebec City, Canada

April 11th, 2008

Nanosciences and Nanotechnology in Canada

- Tremendously active area of research
- Numerous world recognized scientists
- Several leading edge clusters
- Many significant initiatives
- No nationwide initiative



Nanotechnology Initiatives in Canada



National Research
Council Canada
National Institute
for Nanotechnology



nano
québec



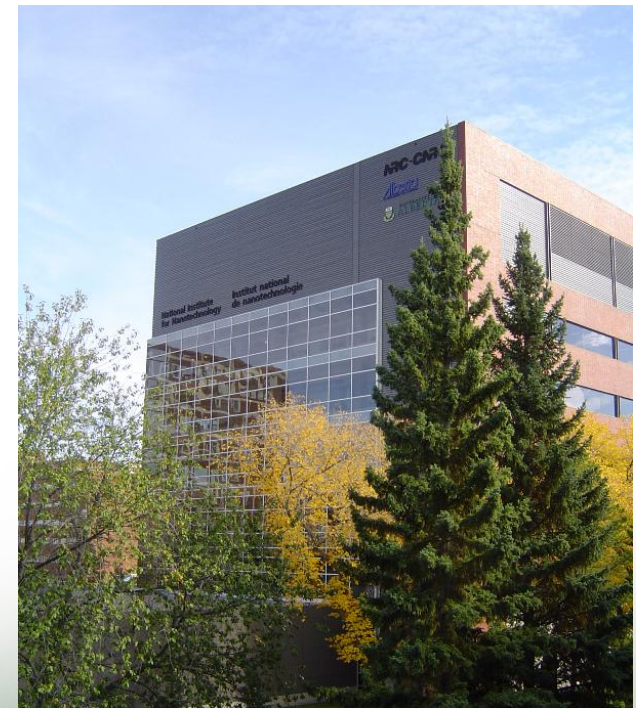
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National Institute of Nanotechnology (NINT)

- Partnership NRC and U. of Alberta
- Vision: Be Canada's flagship nanotechnology institute
- 20,000 m² building
- 120 NRC Staffs, 45 guest workers
- Work focused on interdisciplinary research areas:
 - Devices and Sensors
 - Engineered Materials for Energy
 - Materials and Interfacial Chemistry
 - Molecular Scale Devices
 - Nano Life Sciences/NE3LS
 - Supramolecular Nanoscale Assembly
 - Electron Microscopy
 - Theory and Modeling

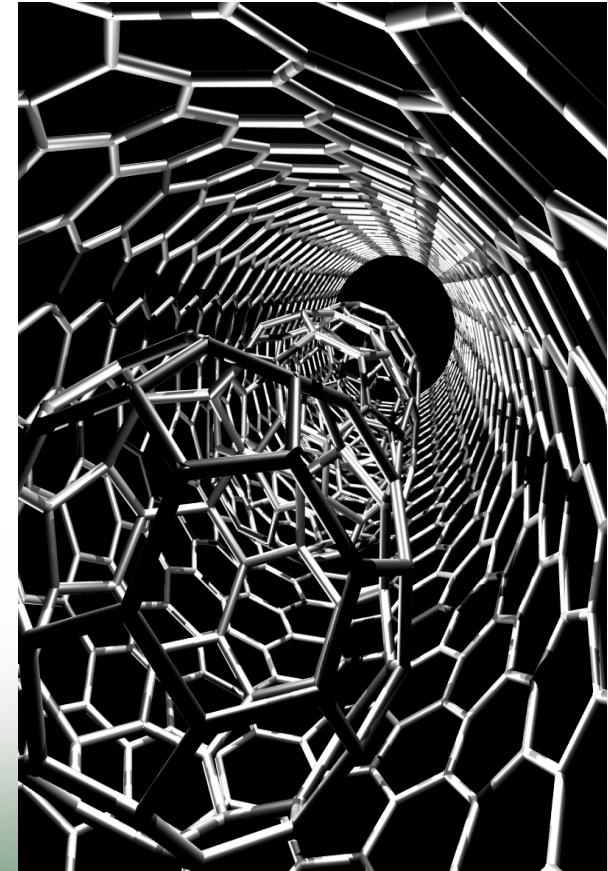


National Research
Council Canada
**National Institute
for Nanotechnology**



Nanotechnologies : A Québec Strength

- A priority clearly stated in Québec Science and Innovation Development Plan
- Over \$400 million invested in infrastructures for nanotechnology research since 2000
- Set up of NanoQuébec
- A well structured network of highly qualified researchers (> 200 professors)
- Strong interuniversity collaborations
- Over 60 nanotech-focused companies (out of 150 in Canada)



Carbon nanotube peapod
A. Rochefort (Ecole Polytechnique de Montréal)



nano
québec

l'avenir des nanos est ici
nanotech's future is here

NanoQuébec: Strengthening innovation in nanotechnologies in Québec and Canada in order to foster sustainable economic development

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www.nanoquebec.ca



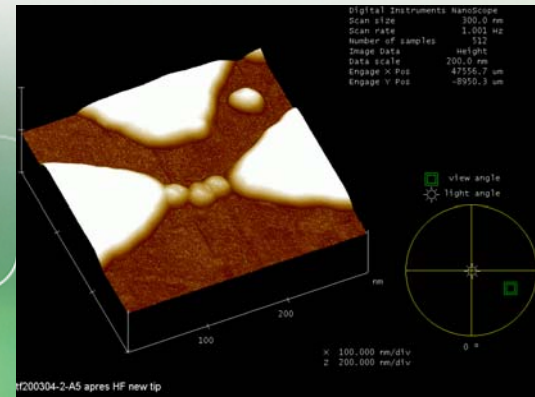
NanoQuébec: A not-for-profit organization

Supported by the provincial and federal governments

- Mission: Strengthening innovation in nanotechnologies in Quebec and Canada in order to foster sustainable economic development
- Promoting industrial applications of nanotechnology and supporting the development of new small and medium nano-businesses
- Training and raising awareness of key stakeholders (researchers, industrials, government, public, etc.)
- Positioning Québec nationally and internationally
- Playing a key role in the responsible development of nanotechnologies NE³LS

Silicon nanocrystals
J. Beauvais and D. Drouin
(USherbrooke)

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NanoQuébec: Investing in key areas

- Support operation and access to a network of major research facilities
- Provide funding for targeted collaborative research programs
- Foster networking and partnerships
- Promote awareness and training



Minatec – Albany Nanotech – NanoQuébec Partnership (May 2005)



Major Research Thrusts

Materials for Electronics and Photonics

- Molecular and organic electronics and optoelectronics
- Magnetoelectronics and spintronics
- Nanostructured surfaces and photonic band gap structures

Soft Materials

- Supramolecular chemistry
- Self-assembly
- Materials and interfaces of biological relevance

Biomedical Materials and Devices

- Drug delivery and targeting
- Tissue engineering and regenerative medicine
- Bio and chemo sensors
- Imaging

Structural and Functional Industrial Materials

- Nanocomposites
- Thin films for mechanical, thermal and optical properties

Multiscale Modeling and Simulation

Ethical, Environmental, Economic, Legal, and Social issues

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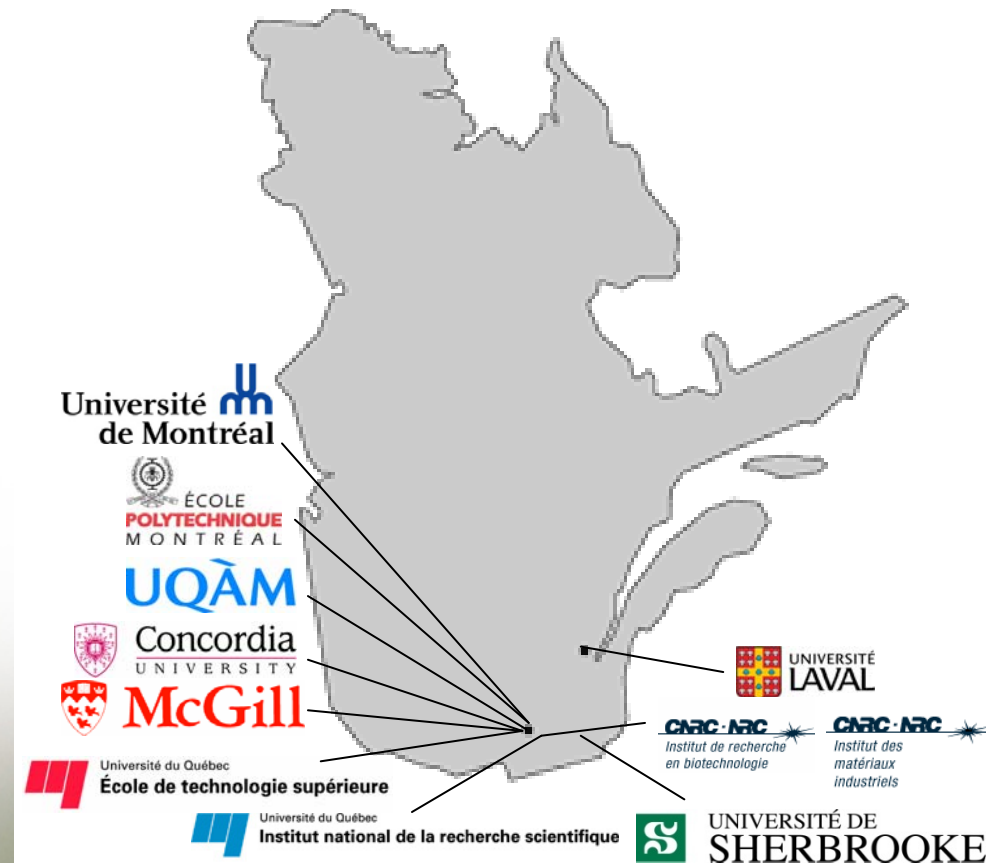
NanoQuébec Major Research Facility Network

7 state-of-the-art facilities covering all areas of nanotech

A newly created consortium of 7 major infrastructures located at different universities (one-stop-shop)

Pooling and facilitating access to instruments and expertises in :

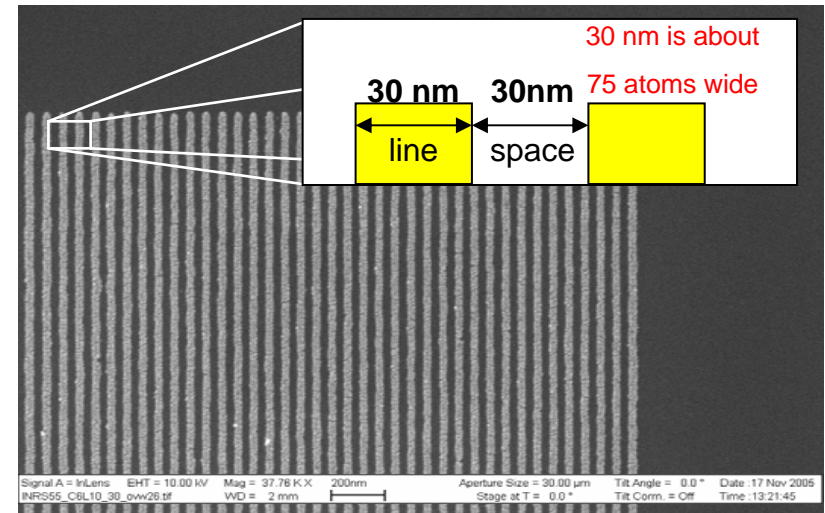
- Nanomaterials
- Nanophotonics
- Nanoelectronics
- Nanosurfaces
- Nanobiotechnology
- Nanomedecine



Quebec's Micro- and Nanofabrication Facilities

Enabling new fabrication techniques and novel devices

- Major infrastructures built through multi-institution CFI projects and other funding programs
- Supported by the Government of Quebec (Staff salaries, upgrades, maintenance, etc)
- Structured within NanoQuebec's network (7 facilities presently supported)



Micro- and Nanofabrication Capabilities

Lithography

⑩ Leica VB6 UHR- EWF

- ⑩ High performance E-Beam tool enabling leading edge nanolithography.

Other lithography techniques

- e-beam writers based on SEM, laser direct writers, ion beam writer, hot embossing nanoimprint, Dip Pen Nanolithography
- advanced resist coatings



EVG and Suss Aligners

- ⑩ Including mask aligners with near-field holography for cost-effective production of nanoscale features

Capabilities (6" wafer)

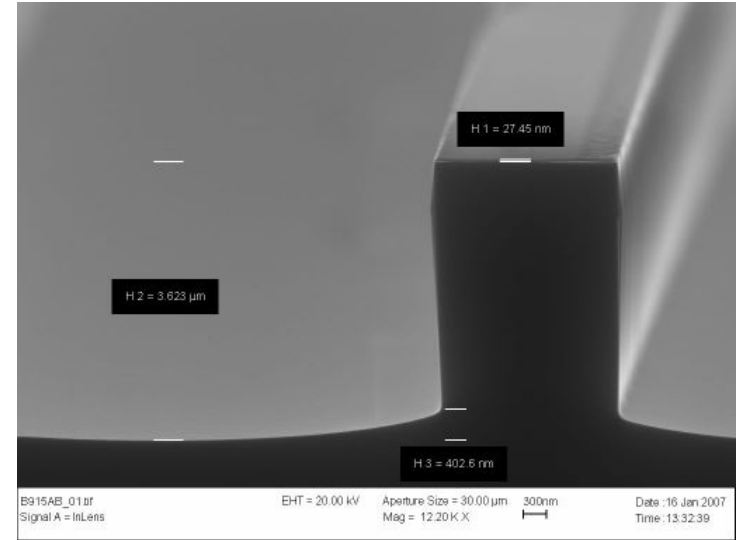
- unique expertise in both e-beam and nanoimprint lithography
- direct writing for mask or device fabrication
- photolithography
- ...

Micro- and Nanofabrication Capabilities

Plasma etching

STS and Oxford DRIE-ICP

With 5 advanced plasma systems from Oxford Instruments and 3 other systems from STS, we have the tools to fulfill a wide range of requirements.



Capabilities (6" wafer)

- unique expertise in both plasma science and plasma etching
- silicon, dielectric and III-V material processes
- new processes for unconventional materials
- deep Si etching for MEMS fabrication

Micro- and Nanofabrication Capabilities

Material deposition and modification

Double ion-beam sputtering

- ⑩ Build for industry, our DIBS system offers exceptional precision and uniformity for optical materials deposition



Chemical Beam Epitaxy



Ion beam implantation and
modification of materials
(10 kV to 6 MV)



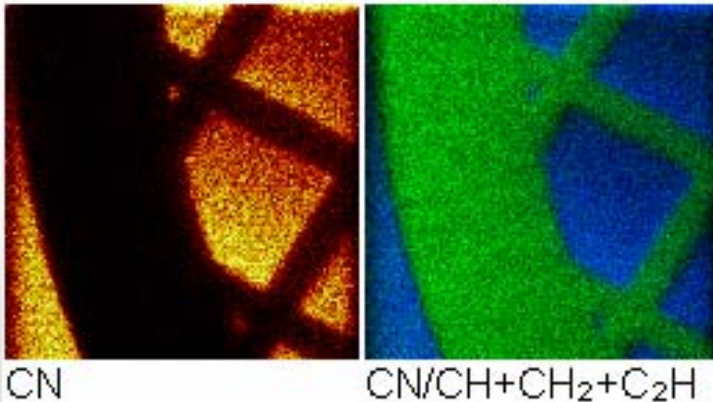
E-beam
evaporator

Micro- and Nanofabrication Capabilities

Materials and devices characterization

TOF-SIMS Imaging

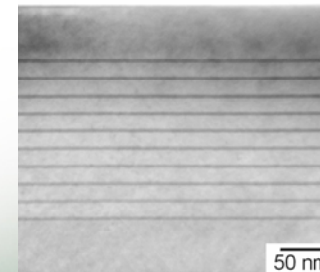
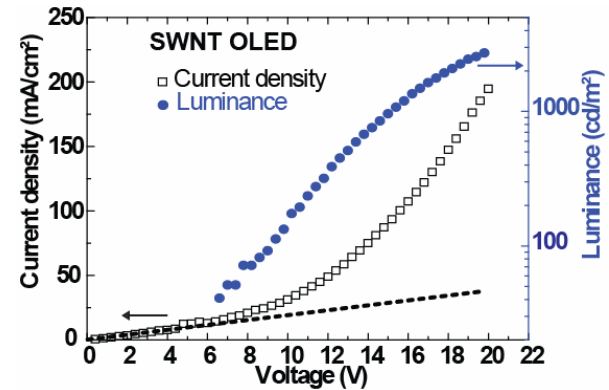
- Plasma-treated polymers for biomedical applications



Time-resolved pump and probe experiments (ps)

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OLED characterization



Transmission electron microscopy
Semiconductor quantum wells

Micro- and Nanofabrication Capabilities

Bonding to packaging

EVG501 Wafer Bonding System

Wafer bonding offers the capability for advanced packaging of MEMS and 3D integration.

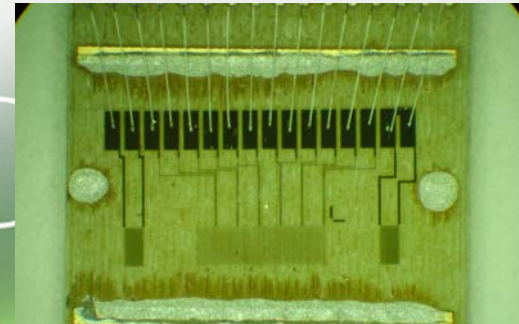


Related techniques

- Wafer bonding, wedge bonding, ball bonding, surface mount track system, wafer dicing, CMP
- Packaging of micro/opto/bio-electronic devices

LASEM

The laboratory for the assembly and encapsulation of electronic microsystems is equipped for hybrid integration.



Optimal Use of Infrastructures

Open access to everyone: academia, government labs, industry (no need to collaborate with PIs)

- Academia
 - Access to state-of-the-art infrastructure
 - Enables cutting-edge research
 - Device fabrication services
 - Autonomous use of equipments
 - Hands-on experience for students
 - Extensive training and scientific support
 - Facilitates access to researchers from all scientific disciplines
 - Expertise and know-how transfer
- Industries
 - Contractual services
 - Microsystems prototyping
 - Failure analysis
 - Adhesion problem solving
 - Chemical mapping of surfaces
 - Collaborative R&D
 - Micro-devices development
 - Sensors development
 - Anti-reflective coating optimization



Ag Nanoparticulee liquid mirror
Ritcy and Borra

NanoQuébec in a nut shell

Nanotechnology R&D is developing effeciently in Québec following a strategic plan

- Well structured network of >200 scientists having research activities covering all aspects of nanotech research
- A government supported network of major infrastructures to facilitate access and to stimulate industry-university collaborative research (>100 industrial users)
- Looking for partnerships
- Looking for collaborations

The Québec Advantage*

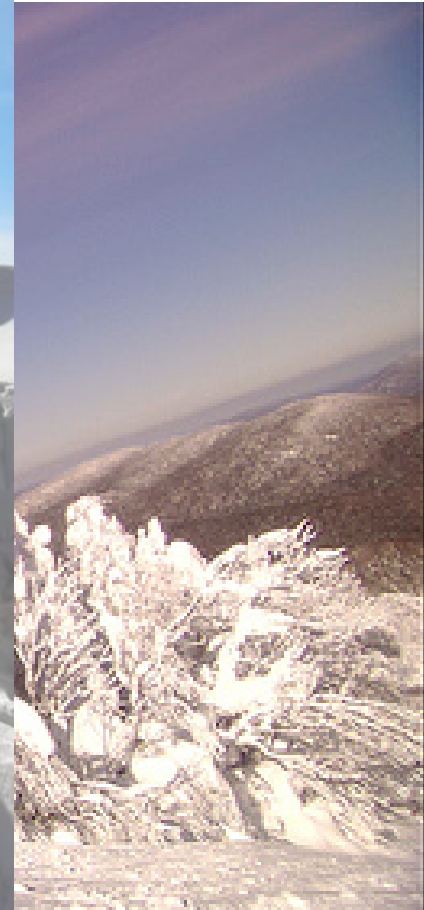
Québec enjoys undeniable strategic advantages that enable it to excel economically

- A competitive business environment
- Economic conditions that are favorable to investment
- A leader in research and innovation
- Availability of highly qualified personnel
- Solidly established key sectors
- Abundant, renewable energy resources

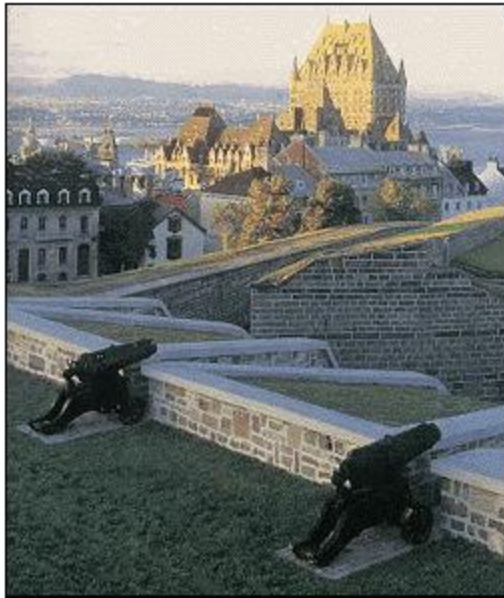
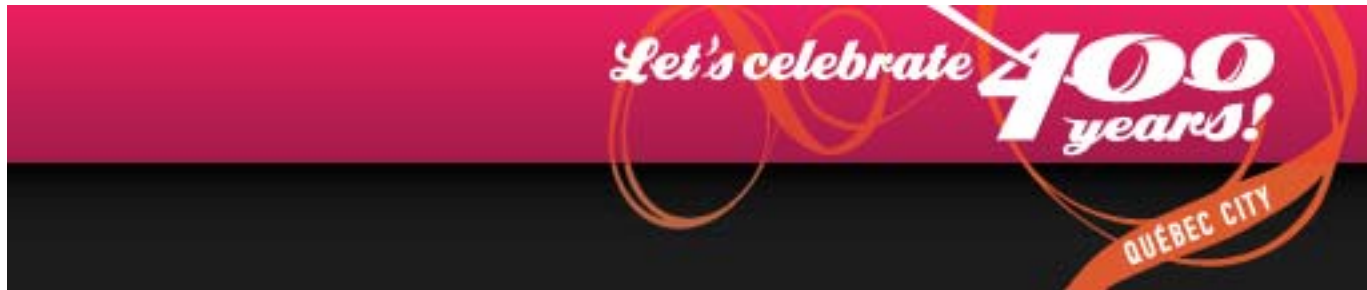
* *The Québec Advantage*, Government of Québec's economic development strategy, 2007

The Québec Advantage*

8 Months without air conditioning needs



2008 Québec City 400th Anniversary



Thank you!

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