

NINT – Supporting Innovative Ideas through Nanotechnology

(Capabilities and Expertise)

Dr. Marianna Kulka, PhD

Group Leader, NINT

National Research Council

Marianna.kulka@nrc.ca

National Institute
for Nanotechnology



Institut national
de nanotechnologie



NRC-CMRC

Alberta
Government

National Institute for Nanotechnology



- Established in 2001, building completed in 2006
- ~ 300 scientists
- Joint initiative between the National Research Council of Canada, the UofA and the Government of Alberta
- Focus on commercialization
- Facilities:
 - Electron Microscopy
 - Probe and Force Microscopies
 - X-ray Analysis
 - Lithography
 - Nuclear Magnetic Resonance Spectroscopy
 - Clean Room
 - -biochemistry, molecular biology and cell biology labs

NINT Programs

- [Metabolomic Sensor Systems](#) – Introduce 10 cost saving diagnostic tests using metabolomic platforms into a clinical environment by 2022.
- [Hybrid Nanoscale Electronics](#) – Enable the genesis of a multi-billion dollar industry in Canada by 2026, based on a transformative nanoelectronics program. In particular, transfer the low heat dissipation and novel systems architecture “Hybrid Nanoscale Electronics” to the Canadian electronics industry.
- [Energy Generation and Storage](#) – Deploy technology that will provide renewable energy storage capacity in the marketplace; in order to support local energy supply, demonstrate organic photovoltaics with 10% energy conversion efficiency lasting 20,000 hours.
- [Nano-Enabled Biomaterials](#) – responsive nanomaterials for use in smart packaging solutions. These include “sensing” materials and antimicrobial coatings.

National Institute
for Nanotechnology



Institut national
de nanotechnologie



NRC-CMRC

Alberta
Government

Building on Success



HITACHI
Inspire the Next

Hitachi Electron Microscopy Product Development Centre

- **\$15 M partnership: Hitachi High Tech. Canada, WED, Alberta Advanced Education and Technology, AITF, UofA and NRC**
- Co-develop of future EM products and further enhance EM capabilities to serve customers



xerox 

Xerox Research Centre of Canada **at NINT's** Innovation Centre

- **Second phase of a \$10 M multi-year, multi-project formal collaboration**
- Focused on 3 distinct product platforms related to its core technologies

National Institute
for Nanotechnology

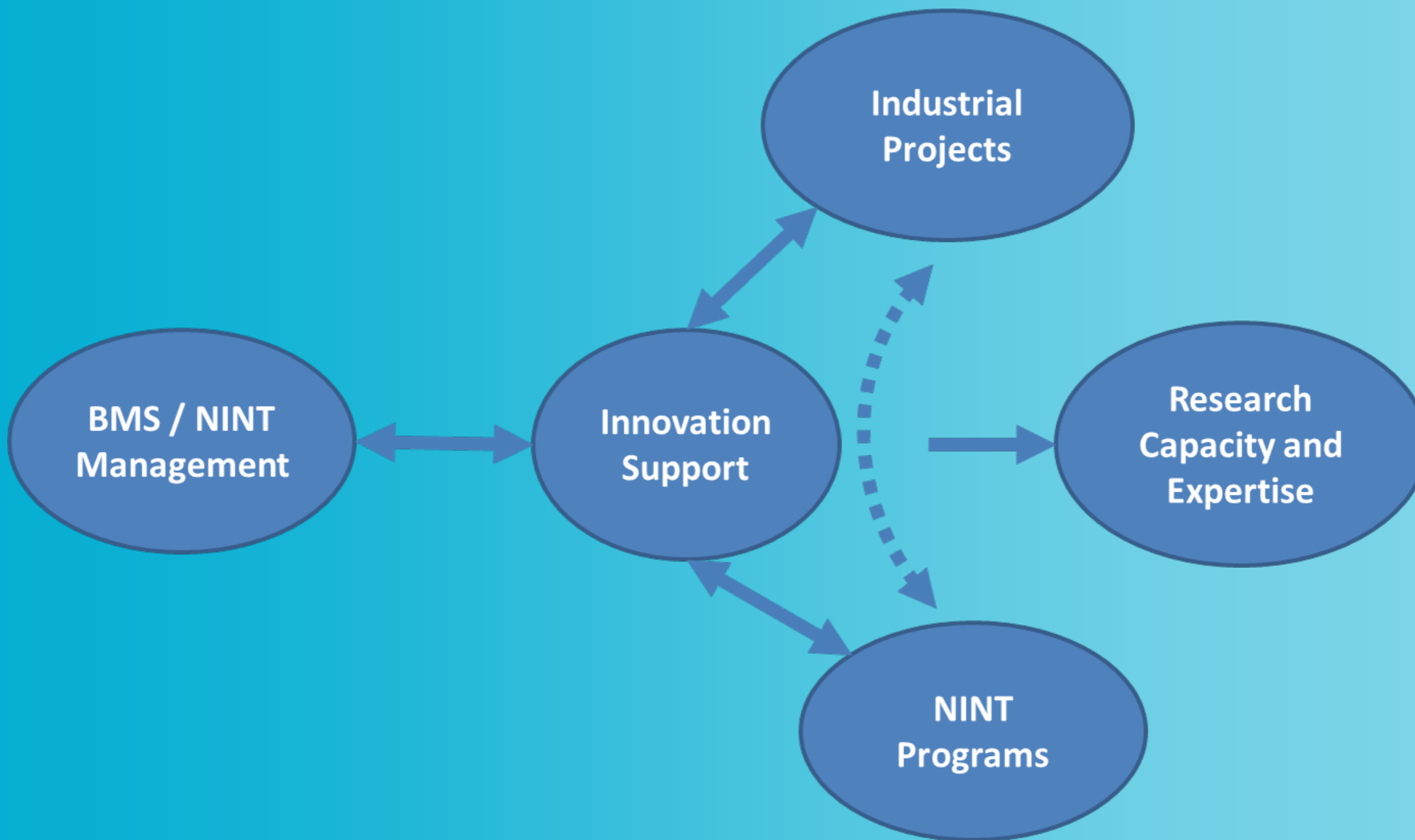


Institut national
de nanotechnologie



NRC-CMRC

Alberta
Government



National Institute
for Nanotechnology



Institut national
de nanotechnologie



NINT Innovation Centre

Dedicated to providing adaptable laboratory and office space for commercial activity, the NINT Innovation Centre serves technology startups and established companies that would benefit from locating close to NINT and University of Alberta facilities and expertise.



Laboratory Facilities

Organic/Inorganic Analytical

- *HPLC, GPC, GC*
- *GC-MS, LC-MS, ESMS*
- *UV-Vis, CD and Fluorescence Spectrometers*
- *Dynamic and Static Light Scattering*
- *FTIR and Raman Spectrometers and Imaging*
- *X-Ray Diffraction*
- *600 MHz Varian NMR*



National Institute
for Nanotechnology



Institut national
de nanotechnologie



UNIVERSITY OF
ALBERTA

NRC-CMRC

Alberta
Government

Clean Room



- **Class 10,000 (1200 sq. ft.) and 1,000 (4000 sq. ft) cleanrooms**
 - **< 1000 particles > 0.5 um – continuous air filters!!!**
 - **area dedicated to lithography – no UV light = yellow**
- **Atomic Layer Deposition, E-Beam Evaporation System, Reactors, Lithography, bonders, etc..**
- **Plans to expand capabilities in prototyping and small scale manufacturing**

National Institute
for Nanotechnology



Institut national
de nanotechnologie



MRC-CMRC

Alberta
Government

NINT Electron and Ion Microscopy



JEOL 2200 FS



Hitachi HF-3300



Hitachi ETEM



Hitachi NB 5000



Hitachi S-5500



Hitachi S-3000N
National Institute
for Nanotechnology



Hitachi S-4800
Institut national
de nanotechnologie



Zeiss NVision

Expertise - Specialties

- **Organic Synthesis - small molecule and polymer**
- **Inorganic Synthesis - nanoparticle synthesis and processing**
- **Probe microscopies – various specialized AFMs**
- **Scanning Tunneling Microscopy**
- **Chemical Vapor Deposition (GLAD) – nanostructured surfaces**
- **Microfluidics**
- **Nanocrystalline Cellulose – Functionalization and Processing**
- **Electrochemistry**
- **Molecular Modelling and Computation**
- **Metallurgy**
- **Engineered biological systems**
- **Nanomaterial Processing:**
 - **Electrospinning Unit**
 - **Orbital Ball Mill**
 - **Ultrasonic Spray Coater**
- **Nanobiology – biochemistry, molecular biology and cell biology**

National Institute
for Nanotechnology



Institut national
de nanotechnologie



MRC-CMRC

Alberta
Government

Nanobiology

Designing “smarter” and “safer” nanoparticles

Understanding how nanoparticles interact with biological processes

Using nanotechnology to understand, facilitate or manipulate biological processes



National Institute
for Nanotechnology



Institut national
de nanotechnologie



MRC-CMRC

Alberta
Government

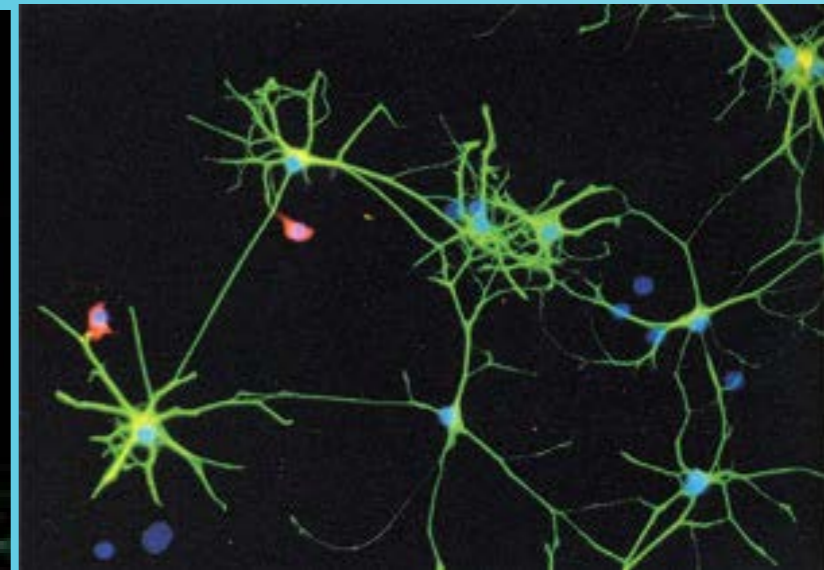
Using nanotechnology to understand biological processes

Improving existing technology or processes

- drug delivery agents (chitosan)
- Imaging and biomarker identification
 - *THz radiation effects on human skin (Frank Hegmann and Olga Kovalchuk)*
- Increase potency

Understand mechanism of action

- bioactivity
- safety



National Institute
for Nanotechnology



Institut national
de nanotechnologie



MRC-CMRC

Alberta
Government

Biomaterials Program

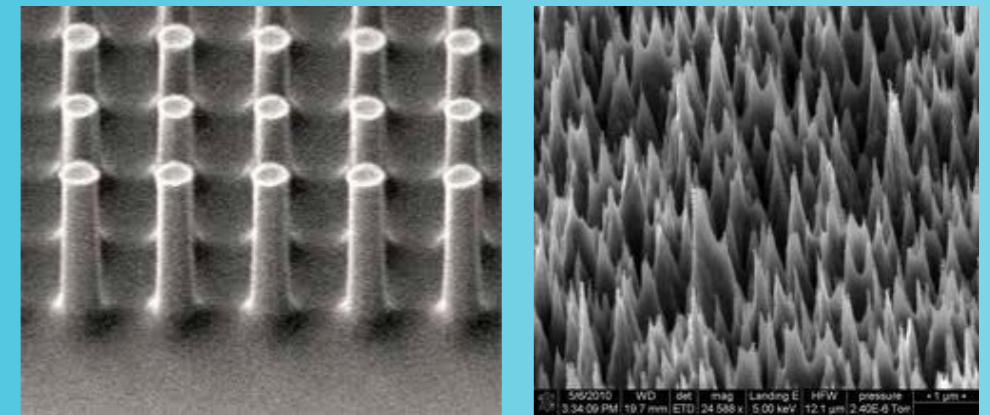
Design of Antimicrobial Coatings

1. Mechanical strategies

- Nanopillars to change adhesive environment of bacteria to surfaces
- Surface topography

2. Chemical strategies

- Phytochemicals such as
 - *polyphenols, terpenes, flavonol*
- naturally-derived products



National Institute
for Nanotechnology



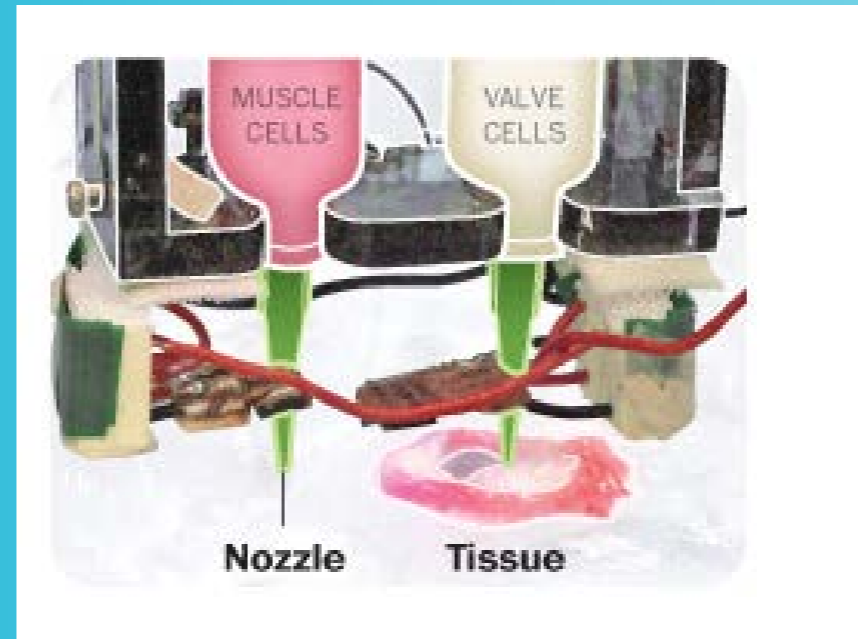
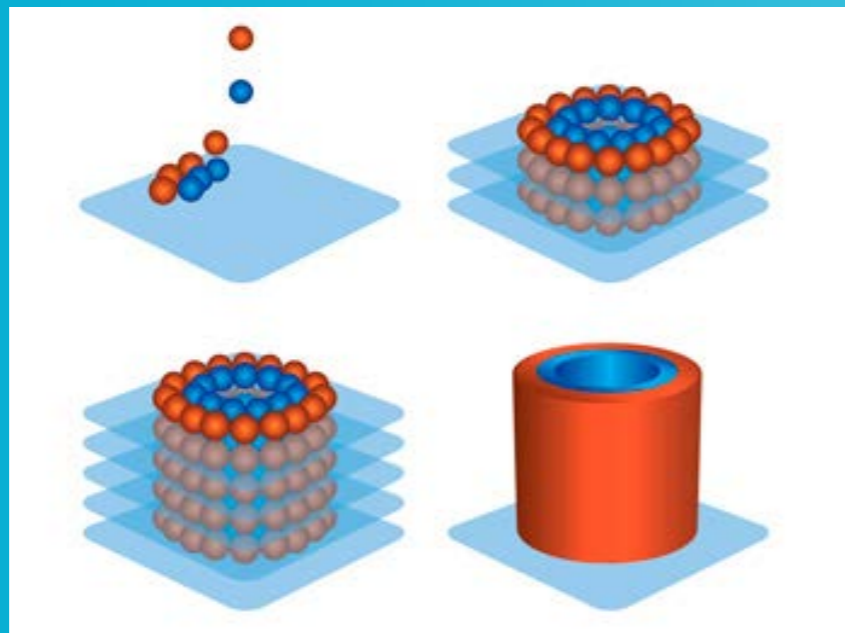
Institut national
de nanotechnologie

Nanomaterials as scaffolds: growing cells, tissues and organs

Organs are composed of many tissues

Tissues are composed of many cell types

Embedded in a 3D matrix of complex structures (nanoscale)



National Institute
for Nanotechnology



Institut national
de nanotechnologie



MRC-CMRC

Alberta
Government

The Collaborative Approach

“To help solve problems that no one else can solve”

expertise at the forefront of
nanoscale research

+

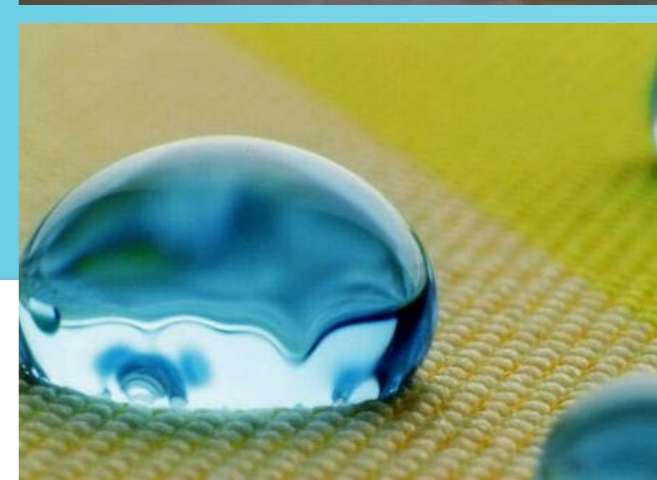
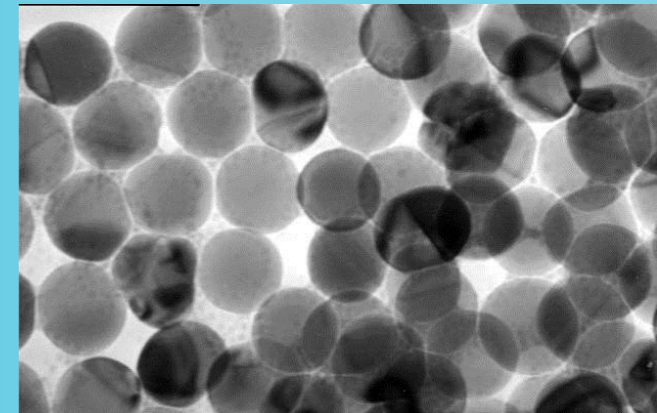
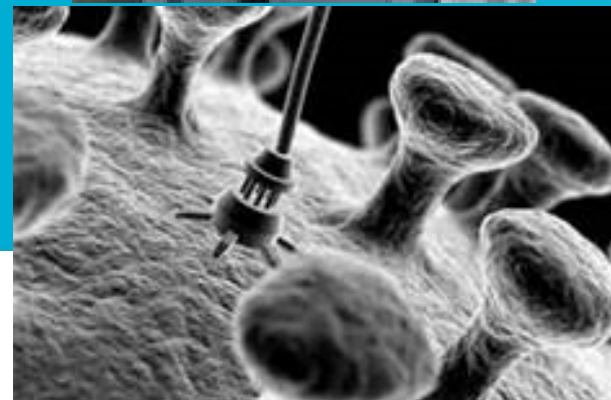
powerful instrumentation

+

unique and **relevant** biological
models

=

innovative applications and
solutions



National Institute
for Nanotechnology



Institut national
de nanotechnologie

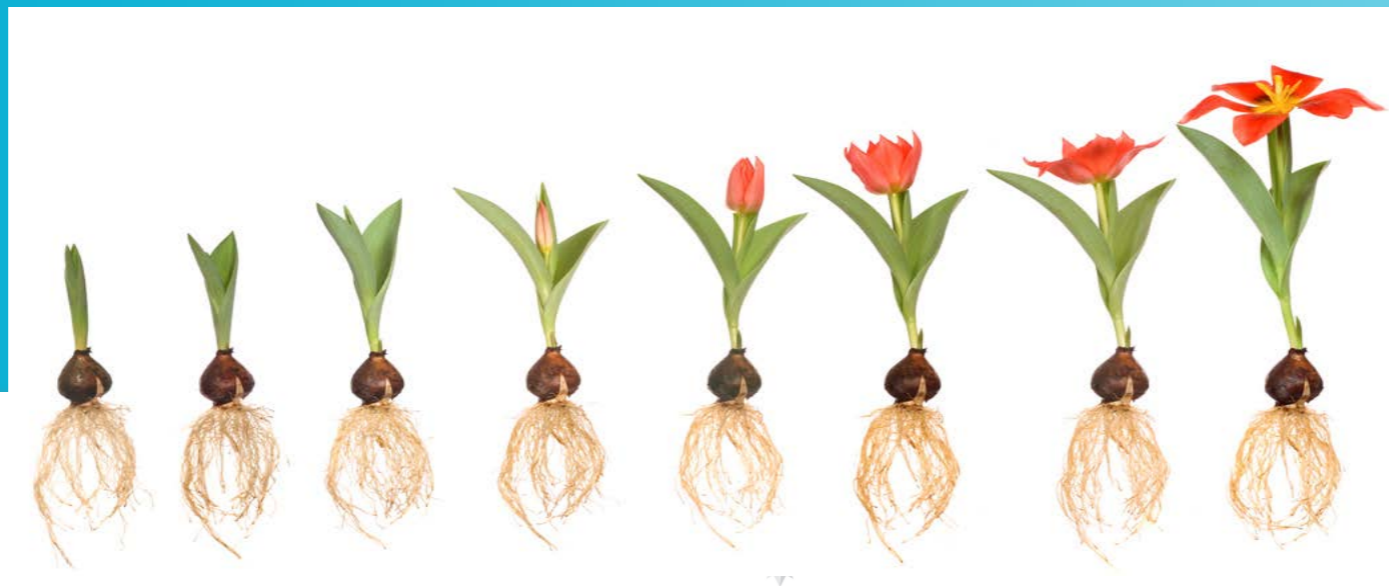
Nurturing the collaborative relationship

Collaborations often begin with pilot projects

Grow over time in scope, expertise, \$

A successful project adds value

- industry (equipment, creates jobs, experience, reputation, diversification)
- collaborator (IP, market strength/scope, HQP, experience, profitable product)



Conclusions:

NINT is a leader in nanotechnology research and characterizations.

The Innovation Support Program is designed to facilitate external collaborations and develop technologies that are ready for introduction into industrial processing.

The program activities are supported by NINT's strategic plan and NRC's Business Management Services.

marianna.kulka@nrc.ca

National Institute
for Nanotechnology



Institut national
de nanotechnologie



NRC·CMRC

Alberta
Government

Thank You

Dr. Marianna Kulka
Group Leader
Innovation Support and Biomaterials
Programs

NINT
Marianna.kulka@nrc.ca

National Institute
for Nanotechnology



Institut national
de nanotechnologie

