NRC capabilities in advanced manufacturing
Advanced manufacturing is the use of innovative technology to improve new and existing products and processes.

Canadian Manufacturers and Exporters
Manufacturing is at the heart of the Canadian economy

MANUFACTURING INNOVATION

Integration of advanced manufacturing technologies with the next generation of information and communication technologies

The 4th industrial revolution

Digitalization of the manufacturing process
NRC is positioned to support advanced manufacturing innovation through its diverse expertise, ability to establish collaboration with industry and academia, and long term holistic approach.
**Polymer and composites**

### High-volume, high-performance composites
- Fibre reinforced thermoplastic and thermoset systems with superior properties
- Reduction of cycle times for stamping of thermoplastic composites, infusion and resin transfer moulding-based manufacturing technologies
- Process mapping, manufacturing guidelines, process modeling
- Part integration / complex parts and efficient multi-material assembly

### Advanced composites manufacturing efficiency
- Out-of-autoclave processes, automation and part integration
- Formulation of resins and optimization of processing to maximize composite performance and quality
- Thermoplastic composites with ease of processing and good recyclability
- Composite performance evaluation, durability testing and prediction
- Nano-reinforced polymer composites and adhesives
- Multifunctional materials and coatings

### Biorefineries and sustainable manufacturing
- Transformation of non food grade biomass (wood, straw, industrial vegetable oils, etc.) into raw materials for the production of bioresins, biofibres and bioadditives
- Formulation, efficient processing and performance evaluation of bioplastics and biocomposites
- Recycling of plastics and composites to minimize environmental impact

### Value-added processing and polymer products
- Lightweighting (plastic glazing, structural foams, compounds, nanocomposites)
- Environmentally-friendly processes and materials (low-toxicity components, solventless processes, recyclability, thermosets replacement)
- Part / component integration (overmolding processes, combining thermoplastic composites with high-strength polymers, polymer 3D printing)
Metal manufacturing

High-performance, high-integrity product forming

- Die-less sheet forming, rapid/low-cost die manufacturing
- Reduce weight with new alloys
- Hot superplastic forming, thin and variable wall extrusion, casting of hollow-core components, etc.
- Hybrid manufacturing (extrusions, forgings, castings)
- Intelligent tooling to improve efficiency and life of tooling

Innovative machining, polishing and surface-finishing technologies

- Increasing material removal rates
- Reduced lead time for new and existing parts
- Zero-scrap generation
- Improved quality and increased tool life
- Reduced waste produced by processes

Assembling of complex multimaterial products

- Joining solutions for specific/complex applications
- Advanced joining techniques for high-integrity application
- Multi-material joining using adhesive bonding, friction stir welding and laser welding

Advanced surface engineering and corrosion protection

- Control of corrosion on multimaterial assembly
- Complex alloy microstructures and relation to corrosion
- Corrosion-assisted fatigue of multimaterials structures
- Design best practices and standards improvement
- Coatings to improve harsh environment durability
Production systems

Flexible manufacturing cells and adaptive manufacturing

- Autonomous and semi-autonomous robots
- Collaborative and human-assisted robots
- Mobile and reconfigurable manufacturing systems

Robotics and mechatronic systems

- Future robotic platforms for assembly, finishing and joining
- Future robotic platforms for part manufacturing
- Adaptive robots

Metrology and sensing

- Sensing technologies and sensing systems
- In-line measurement
- Non-destructive testing
- Quality assurance

Additive manufacturing

- Cold spray
- Electron beam deposition system
- Laser deposition system
- Material characterization
- Formulation of high-performance polymers and composites for additive manufacturing
Digital manufacturing

Design to manufacture and performance evaluation

- Crash worthiness
- Manufacturing data object
- Computer-aided design
- Computer-aided manufacturing
- Computer-aided engineering
- Finite element analysis
- Computational fluid dynamics
- Product lifecycle management
- Bills of materials

Machine vision

- 3D vision systems
- Imaging sensors
- Processing and analysis software
- Geometric modeling and dimensional inspection
- Big data analytics

Digital manufacturing and IoT

- Smart factories
- Industry 4.0
- Industrial Internet of things
- Artificial intelligence
- Sensor integration
- High-performance material formulations; nanocomposites

Modelling and process simulation

- Blow and injection molding
- Forming
- Machining
- Additive and surface treatment
- Composites manufacturing
- Assembly processes
# Photonics manufacturing

## Canadian Photonics Fabrication Centre
- Catalyst for photonic R&D and manufacturing in Canada
- Tier 3 and 4 capability enabling higher value-added tier 1, 2 and original equipment manufacturer activity
- Telecommunications
- Data centers
- Defence
- Aerospace
- Clean energy

## Advanced materials
- Enabling supply and growth of commercial volumes for compound semiconductors
- Materials for environmental sensing
- Materials for multi-spectral imaging (machine vision)
- Advanced material growth for communications

## Component fabrication
- Full product life cycle management from technology readiness level 3 to 9
- Light generation, delivery and detection
- Lasers
- Sensors
- Multi-spectral imaging
- Photonic integrated circuits

## Design test verification
- Modeling of next-generation photonic platform technologies
- Simulation of complex photonic machines
- Integrated design for manufacturing
- Industrial engagement for the deployment of enabling photonic technologies
# Life sciences manufacturing

**Biomanufacturing – innovative products**

- Therapeutics and vaccine generation
- Biomanufacturing
- Advanced analytics and characterization for biologics and vaccines
- Proprietary cell line development
- Preclinical development

**Medical device – innovative products**

- Microfluidics and biosensors
- Novel material architectures for implantable devices
- Medical photonics, radio frequency and microwave antennas
- Computer simulations

**Biomanufacturing pilot plant – process improvement**

- Industrial process development for upstream and downstream optimization
- Advanced analytical
- De-risked tech transfer to industrial partners

**Pilot plant of the future – next generation**

- State-of-the-art equipment inline with industry standards
- Improved productivity and speed
- Reduced safety concerns and cross contamination
Key enabling platform technologies

Artificial intelligence
- Computer vision and image understanding
- Adaptive robots; future robotic platforms for part manufacturing
- Understanding human emotions from language
- Next generation information extraction using deep learning
- Speech recognition
- Artificial intelligence to optimize talent management for human resources

Nanomaterials
- Nanoelectronics
- Nanosensing
- Smart materials
- Nanocomposites
- Self-assembled nanostructures
- Nanoimprint
- Nanoplasmonic
- Nanoclay
- Nanocoating

Big data analytics
- Predictive equipment maintenance
- Energy management
- AI for optimizing energy storage and distribution
- Understanding and tracking of hazardous chemical elements
- Process and design optimization

Printed electronics for Internet of Things
- Inks and materials
- Printing technologies
- Large area, flexible, stretchable, printed electronics components
- Applications: sensors for Internet of Things, wearables, antenna, radio-frequency identification tags, smart surfaces, packaging, security, signage

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London, ON
• Additive manufacturing
• Process design, modelling, simulation
• Manufacturing systems engineering and integration
• NEW (Automotive advanced manufacturing solutions center)

Edmonton, AB
• National Institute for Nanotechnology (NINT)

Winnipeg, MB
• NEW (Advanced manufacturing centre)
• Process design, modelling, simulation
• Manufacturing systems engineering and integration
• Flexible manufacturing pilot laboratory

Ottawa, ON
• Machine vision
• Big data analytics
• Metrology
• Materials characterization and testing
• Canadian photonics fabrication centre

Mississauga, ON
• NEW (Canadian campus for advanced materials manufacturing)
• Advanced materials for digital manufacturing, printed electronics, smart objects, devices, sensors, etc.

Montreal/Boucherville, QC
• Intelligent machining processes and tooling
• Robotics and automation
• Modelling and simulation
• Advanced materials
• Medical devices
• NEW (Aerospace advanced manufacturing solutions centre)

Montreal – Royalmount, QC
• Biomanufacturing pilot plant
• Advanced biologics analytics

Saguenay, QC
• Lightweighting structural
• Aluminium joining and forming
• Aluminium and multi-materials assembly
• Hybrid manufacturing (extrusions, forgings, castings)

NRC collaboration platform locations

Advanced manufacturing
For further information on how the NRC can support your **advanced manufacturing** needs, contact:

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