Shaping the future with you

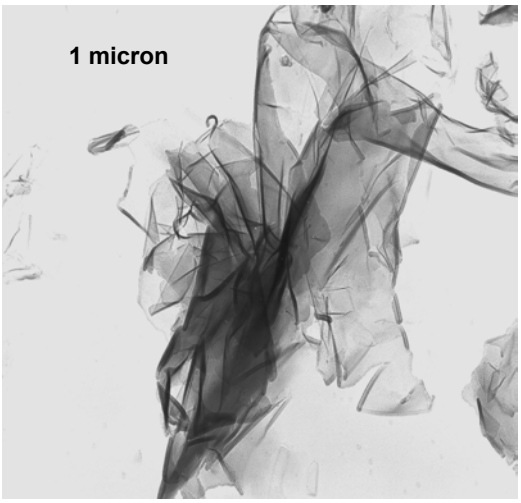
INFORMATION

Polymer Nanocomposites

The Industrial Materials Institute (IMI) of the National Research Council of Canada (NRC) is currently spearheading expertise in the field of polymer nanocomposites.

Nanotechnology is recognized as one of the most promising avenues of technology development for the 21st century. In the materials industry, the development of ceramic and polymer nanocomposites is a rapidly expanding multidisciplinary research activity.

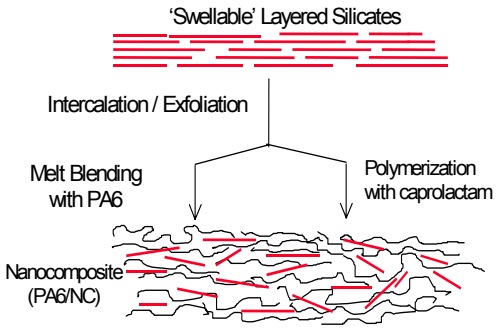
Polymer nanocomposites are a class of reinforced polymers with low quantities (< 5%) of nanometric-sized clay particles.



Micrograph (TEM) of the morphology of montmorillonite (clay)

These minerals considerably increase the mechanical and thermal properties of standard polymers, notably by:

- improving fire resistance and barrier properties
- improving the performance of materials without significantly increasing the density of the polymer, changing its optical properties or its recycling



Nanocomposite formation

Activities focus on the following areas:

- developing methods to modify clay surface properties for specific applications
- preparing nanocomposites through polymerization
- preparing nanocomposites using melt blending technologies
- preparing nanocomposites from polymer blends

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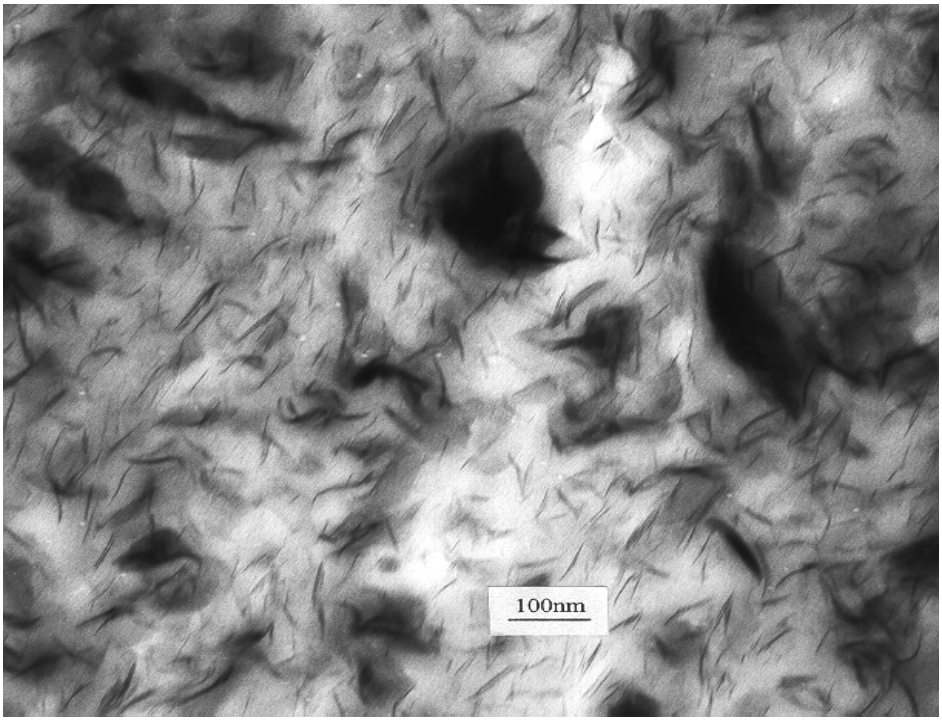
- developing nanocomposite characterization techniques: rheology, microstructure, thermal, thermodynamic and mechanical analyses, (in the short- and long-term)
- forming of nanocomposites (injection moulding, blow moulding, film blowing, blowing, foam extrusion, etc.)



Morphology of nanocomposites (TEM micrograph)

Research Activities

Development of clay surface modification technologies for specific applications

Research into clay modification allows us to:

- modify the surface of nanoparticles by treating them with organic agents in order to obtain systems having specific surface and microstructural properties (improved exfoliation during compounding, compatibility with a given polymer, and thermal stability)
- optimize polymerization conditions in order to maximize performance and minimize costs
- study the effect of the nanocomposite composition in the microstructure's development during the processing

Preparation of nanocomposites through melt blending technologies

These activities focus on optimizing the blending processes for nanocomposites in their melted state. Parameters studied include:

- the configuration of the twin-screw extruder and screw elements
- processing conditions (temperature, rpm, clay feeding system)

Preparation of polymer composite-nanocomposite blends

The group is targeting the development of composite-nanocomposite blends to take advantage of the properties of individual components as well as their synergy.

Development of nanocomposite characterization techniques

These activities deal with the characterization of the behaviour of nanocomposites according to their properties. The following properties are studied:

- rheologic
- thermal (enthalpy, thermal capacity, crystallization kinetics)
- thermodynamics (PVT behaviour, equation of state, gas permeability)
- short- and long-term mechanical behaviour (stress-deformation, fatigue life, fatigue-propagation, low-speed impact, durability, fracture behavior)
- characterization of the effects of the time-temperature-pressure processing conditions on the microstructure development (orientation, distribution et interaction of nanoclays)

Nanocomposite forming

These activities aim to study the feasibility of moulding nanocomposites and better understand the parameters that have an influence on the performance of the product. Forming procedures studied are :

- injection moulding
- blow moulding
- foam extrusion
- film blowing

Industrial Applications

Several potential applications have been identified in the following industrial sectors:

- automobile (gasoline tanks, bumpers, interior and exterior panels, etc.)
- construction (shaped extrusions, panels)
- electronics and electrical (printed circuits, electric components)
- food packaging (containers, films)

Industrial Materials Institute's facilities at Boucherville, Quebec

Technology Transfer

Companies with R&D needs can benefit from several progressive technology transfer opportunities. The work can be carried out in the form of:

- a joint project with an integrated approach which could involve other expertise available at IMI in modelling and control
- a feasibility study for process or product validation
- technical support involving specific or unique expertise or equipment

Information

To learn more about these and other technologies, to benefit from NRC's R&D resources and give your firm a technological advantage, you are invited to contact IMI representatives.

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Industrial Materials Institute
National Research Council Canada
75 de Mortagne Blvd.
Boucherville, Québec, J4B 6Y4
Internet : www.imi.nrc.ca

Dr. Johanne Denault
Group Leader, Polymer Composites
Tel. : (450) 641-5149
Fax : (450) 641-5105
E-mail : johanne.denault@nrc.ca

Blaise Labrecque
Business Development Officer
Tel. : (450) 641-5299
Fax : (450) 641-5105
E-mail : blaise.labrecque@nrc.ca

Ce document est également offert en français

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