Ideas on the Edge

Playing the Clay Card for Better Plastics

QUEEN'S RESEARCHER MARIANNA KONTOPOULOU HAS A FEW ACES UP HER SLEEVE WHEN IT COMES TO CREATING A STRONGER GENERATION OF PLASTICS.

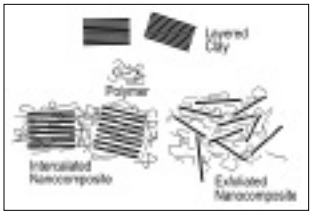

MARIANNA KONTOPOULOU

"Imagine clay as a pack of cards," explains Queen's University materials scientist Dr. Marianna Kontopoulou. "The layers are very, very thin—a nanometre in thickness—but they have a large surface area."

And…?

You may wonder why Dr. Kontopoulou is talking about clay, given that her research specialty is plastics. But you soon have your answer. "If you can separate these stacked layers, and disperse them inside a polymer," she continues, "you can take advantage of that high surface area to add a lot of strength."

To understand where the Queen's university materials scientist is going with this, think of a house under construction. Even when the frame of studs and rafters is complete, it's still a pretty rickety affair. But nail sheets of plywood and drywall to that frame, and the house becomes absolutely rigid. It's not the thickness of the sheets that adds the strength; it's the large surface area. Adding microscopic "playing cards" of clay to a plastic produces a similar result. Chemically "nailed" to the framework of molecules that make up a polymer, they introduce enormous strength.

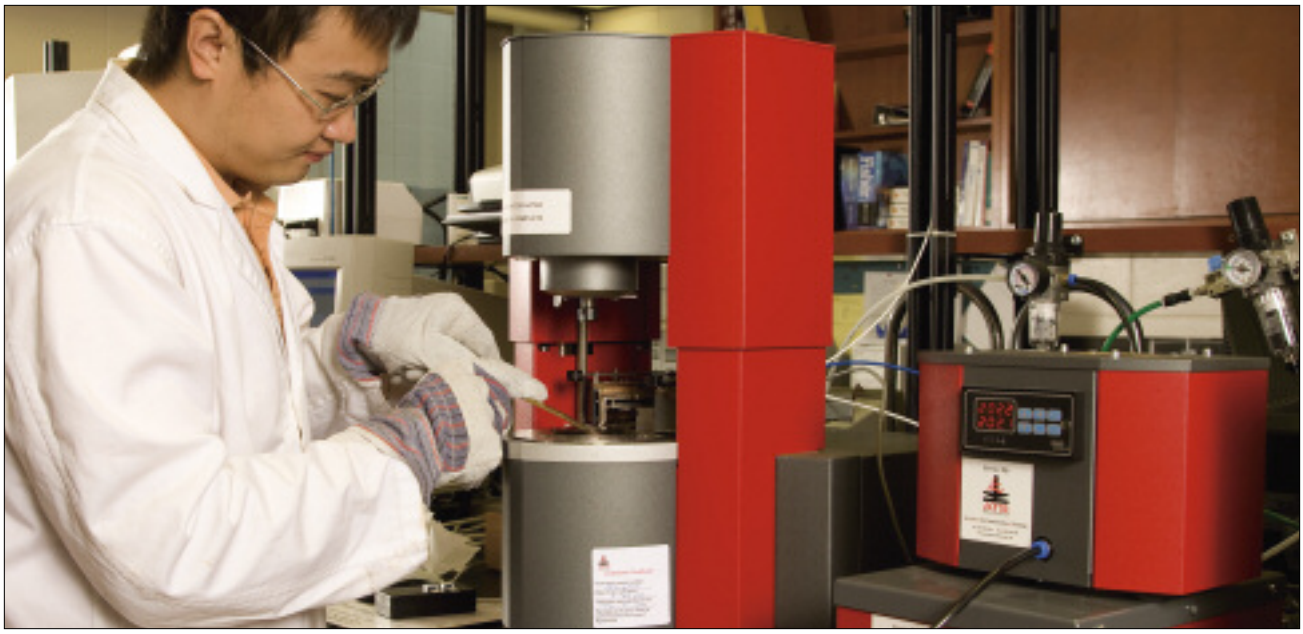


DIFFERENT WAYS TO DEAL THE CARDS: WHEN ADDED TO A POLYMER TO MAKE A NANOCOMPOSITE, THE LAYERS OF CLAY CAN MAINTAIN THEIR LINKED STRUCTURE—MAKING THE MATERIAL MORE RIGID (LEFT)—OR BE RANDOMLY DISTRIBUTED FOR EASIER WORKABILITY (RIGHT).

Dr. Kontopoulou and her colleagues are working on new ways to create these plastic-clay "nano-composites." But it's not as easy as the deck-of-cards analogy makes it sound. The process of evenly distributing and attaching the sheets of clay to molecules of polymer involves manipulating both materials at the nanometre scale—we're talking a millionth of a millimetre. And the only way to make that happen is through some very advanced chemistry.

The scale may be tiny, but the implications are huge—especially for the

TRUST FUNDED EQUIPMENT AT QUEEN'S LETS RESEARCHERS CREATE AND TEST NEW HYBRIDS OF PLASTIC AND CLAY.



auto industry. The strength of plastic-clay nano-composites, plus the fact that they weigh much less than steel, promises cars that are more durable, safer and more fuel efficient. And the new materials use less plastic, reducing costly oil consumption. Carmakers are already putting them to work in a growing number of applications.

For her part, Dr. Kontopoulou is pushing the outside of the automotive polymer envelope even further. Using specialized devices funded in part by the Ontario Innovation Trust, she's collaborating with the University of Toronto on a new generation of plastics that are "foamed" with microscopic air bubbles. "This makes them even more light-weight," she explains, "and leads to other improvements like shock absorbency and noise reduction." And building on what she's learned about clay nano-composites, she's experimenting with an alternate partner for polymer: silica. The three dimensional spherical shape of silica molecules— as opposed to the playing card structure of clay—promises a new generation of even stronger materials.

Stay tuned for a new recreational metaphor: "Imagine silica as a gym full of basketballs…"

RESEARCH THAT MATTERS

REAL-WORLD BENEFITS FOR ONTARIANS:

- lighter, safer, more environmentally friendly cars
- leadership for Ontario in automotive engineering

Project: Laboratory for the Evaluation of Rheology, Morphology, and Structure of Automotive Polymers
Institution: Queen's University
Research Sector: Engineering
Principal Investigator: Marianna Kontopoulou
Trust Investment: $119,542
CFI Investment: $119,542
Total research investment from all sources: $298,855

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Infrastructure for Innovation
About the Ontario Innovation Trust

The Ontario Innovation Trust was created in 1999 by the Government of Ontario to invest in research equipment and facilities at Ontario's universities, colleges, hospitals and other non-profit research institutions. The Trust is governed by a volunteer Board of Directors, according to the terms of a Trust agreement established by the Ontario government. A small permanent staff looks after day-to-day operations.

Since its inception, the Trust has committed almost $843 million to strengthen Ontario's position in the global marketplace of ideas. This represents more than a third of the $2.44 billion in total funding that has been invested in Trust-supported projects.