# Breaking the Ice

## New nanomaterial could soon keep hydro wires ice-free

*By Monique Roy-Sole*
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One of the most enduring images of the ice storm which paralyzed eastern Ontario and western Quebec in 1998 is that of power lines and towers snapping like matchsticks under the weight of ice. Averting such costly disasters in the future may soon be possible thanks to newly developed nanomaterial coatings that can prevent ice and snow from accumulating on power-grid equipment.

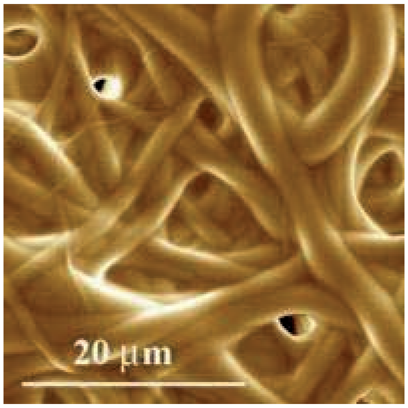
The team of the Nanomaterials and Surface Engineering Laboratory
*Masoud Farzaneh*

In the laboratories of the Université du Québec à Chicoutimi's (UQAC) **research centre on atmospheric icing** — the largest of its kind in the world — **Masoud Farzaneh** and his team have created nanostructured coatings that repel freezing rain and ice. "Since there are practically no solid materials to which ice doesn't adhere," says Farzaneh, "we thought of developing superhydrophobic and icephobic nanocoatings."

For the electrical engineer and Iranian native who came to UQAC as a visiting professor in 1982, nanotechnology — the manipulation of materials or devices at the atomic or molecular level — opened up the possibilities. Farzaneh's research team was inspired by the thin outer membrane of butterfly wings and lotus leaves, which naturally repels water because it resembles a bed of nails. When they reproduced a similar relief to create a hydrophobic material, Farzaneh says, "raindrops pearled and reacted like ping-pong balls that bounce and fall away."

But the first coatings didn't effectively ward off freezing rain and ice. In the lab, where severe ice and cold conditions can be simulated, Farzaneh and his team experimented with the chemical composition of the coating, as well as the size, shape and distance between the nano "nails" before finally developing a coating that could keep ice from forming on the exposed surfaces. After five years of research, they succeeded in creating anti-icing shields.

Superhydrophobic polymer fibers obtained by electrospinning
*Masoud Farzaneh*




Superhydrophobic polymer fibers obtained by electrospinning (under electronic microscope)
*Masoud Farzaneh*

Plasma reactor for chemically deposited films
*Masoud Farzaneh*

To understand the mechanics of how ice sticks — or doesn't stick — to a surface is a "historic step," says Farzaneh, who holds the Industrial Chair on Atmospheric Icing of Power Network Equipment (called CIGELE) at UQAC, established, fortuitously, four months before the great ice storm of 1998. While more work remains to be done to take the new product from controlled lab conditions to industrial applications outdoors, Farzaneh says the anti-icing shield could have unlimited uses in cold climates, such as being applied to airplane wings, wind turbine blades, bridges, communication towers and, cars.

Industry may also reap considerable economic benefits. "A process that prevents ice from sticking to power network structures and conductors would represent substantial cost savings, particularly in the event of an ice storm of the magnitude of the one in 1998," says Hubert Mercure, manager of electrical equipment for Hydro-Québec's research centre in Varennes, Que. In the decade since the ice storm, the utility has spent nearly $2 billion repairing and reinforcing the province's power grid.

Plasma reactor for chemically deposited films
*Masoud Farzaneh*

The next step for Farzaneh's team is to test the stability, durability and aging of the anti-icing coatings to help reach large-scale commercial application. Companies have already started inquiring about the technology. "Imagine the day when we'll be able to apply this product on equipment," says Farzaneh. "It will be a revolution, I'd say, because in northern countries, strategic infrastructure is always going to be exposed to icing."