NASA continues to seek out innovation that provides unique solutions to difficult problems. NASA iTech was created to not only identify breakthrough technologies that address pressing issues here on Earth, but ones that also hold great promise in overcoming critical space-exploration challenges. All ingenuity is welcome, whether generated by business, academia and government organizations, or by any others who wish to make their leading-edge products and processes known to NASA leadership and agency partners in the private and public sectors.

University of Houston

Biologically Inspired Anti-Icing Treatment

Sliding down a slippery slope is no metaphorical exercise for those suffering in a brutal winter of snow and ice. When ice piles up, trees fall, and utility poles topple. Heavy ice accumulation can disrupt communications and power for days while utility companies repair extensive damage. Even relatively small ice storms prove extremely dangerous to motorists and pedestrians. Bridges and overpasses are especially hazardous because they freeze before other surfaces.

Black ice is a particularly pernicious threat. Not easily seen, it is most prevalent during the early morning hours, either after an overnight cold rain followed by a hard freeze, or a snow melt that refreezes as temperatures plummet in pre-dawn hours.

According to the Federal Highway Administration, between 2005 and 2014, an average of 1,836 deaths and 136,309 injuries per year were attributed to snowy conditions and icy roads.

A new approach can help mitigate such perils. University of Houston Cullen School of Engineering Assistant Professor Hadi Ghasemi and his research team have devised a new adaptive anti-icing material that is being readied for transfer directly from the laboratory into the consumer marketplace.

To commercialize the compound, Ghasemi has founded a start-up called SurfEllent.

Biologically Inspired

Ghasemi's innovation was motivated by the adaptive behavior of wood frogs, animals that can freeze up to two-thirds of their body during wintertime, but somehow remain alive. During this suspended animation, a wood frog's respiration ceases and its heart stops.

A kind of antifreeze-like substance fills the spaces between the wood-frog cells but doesn't actually freeze the cells themselves, which would prove fatal. Water within the cells is effectively replaced, triggering a kind of cellular dehydration. During springtime thawing, water flows back into the wood frog's cells, returning them – and the frog – to full function.

SurfEllent's icephobic properties are made possible by a combination of various polymers: chemical units bonded together, as found in human-created plastics and resins.

Application of the new material prevents ice adhesion, and can be sprayed or bushed on any surface, including wood, metal, plastics and ceramics.

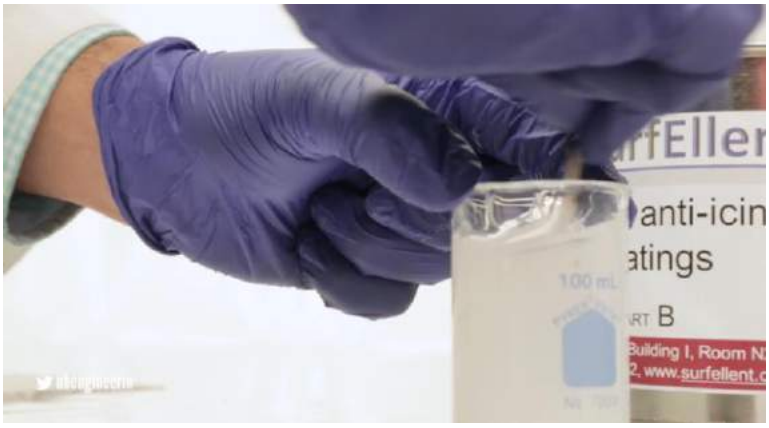
On the left, tough-to-break ice builds up on an untreated surface. On the right, SurfEllent application reduces ice accumulation and allows whatever remains to be easily removed.

A Critical Commercial Role

You'd be hard-pressed to find durable ice-phobic surfaces or coatings on the market today. Ones that are presently commercially available quickly lose anti-icing properties due to prolonged environmental exposure and so must be reapplied frequently. By comparison, SurfEllent anti-icing coatings can last up to seven years after a single application.

Ghasemi believes SurfEllent could play a critical role in a wide range of industries, from transportation to energy, cryobiology, and food engineering. A few grades of anti-icing products are currently commercialized and are available for online purchase through www.surfellent.com.

The National Science Foundation has rewarded Ghasemi's focus with a $290,000 grant for his project titled "Nano-Scale Physics of Icephobicity and Path Toward Durable Icephobic Surfaces." The multi-disciplinary project involves studies of thermodynamics, heat transfer, and mechanics.



Other materials created by Ghasemi and his research team include (1) a new magnetic slippery surface known as MAGSS, which can be applied to any surface including ceramics, polymers, and metals and (2) stress-localized coatings with remarkable mechanical, environmental and chemical durability.

Professor Hadi Ghasemi intends to quickly move SurfEllent from the laboratory to the marketplace. "Our goal is to put this material on the shelves of stores like Home Depot so every consumer can buy and apply it themselves," he says.

More information available SurfEllent, Lab to Market Video Series, NSF Grant to Study Ice Formation and Fight Icing and Lab to Market: Next-Generation Anti-Icing Coatings