Creating a coating of water-repellent microscopic particles to keep ice off airplanes

16 November 2012

To help planes fly safely through cold, wet, and icy conditions, a team of Japanese scientists has developed a new super water-repellent surface that can prevent ice from forming in these harsh atmospheric conditions. Unlike current inflight anti-icing techniques, the researchers envision applying this new anti-icing method to an entire aircraft like a coat of paint.

As airplanes fly through clouds of super-cooled water droplets, areas around the nose, the leading edges of the wings, and the engine cones experience low airflow, says Hirotaka Sakaue, a researcher in the fluid dynamics group at the Japan Aerospace Exploration Agency (JAXA). This enables water droplets to contact the aircraft and form an icy layer. If ice builds up on the wings it can change the way air flows over them, hindering control and potentially making the airplane stall. Other members of the research team are with the University of Tokyo, the Kanagawa Institute of Technology, and Chuo University.

Current anti-icing techniques include diverting hot air from the engines to the wings, preventing ice from forming in the first place, and inflatable membranes known as pneumatic boots, which crack ice off the leading edge of an aircraft's wings. The super-hydrophobic, or water repelling, coating being developed by Sakaue, Katsuaki Morita – a graduate student at the University of Tokyo – and their colleagues works differently, by preventing the water from sticking to the airplane's surface in the first place.

The researchers developed a coating containing microscopic particles of a Teflon-based material called polytetrafluoroethylene (PTFE), which reduces the energy needed to detach a drop of water from a surface. "If this energy is small, the droplet is easy to remove," says Sakaue. "In other words, it's repelled," he adds.

The PTFE microscale particles created a rough surface, and the rougher it is, on a microscopic scale, the less energy it takes to detach water from that surface. The researchers varied the size of the PTFE particles in their coatings, from 5 to 30 micrometers, in order to find the most water-repellant size. By measuring the contact angle – the angle between the coating and the drop of water – they could determine how well a surface repelled water.

The team will present their findings in a poster session at the American Physical Society's (APS) Division of Fluid Dynamics (DFD) meeting, which will take place Nov. 18 – 22, 2012, at the San Diego Convention Center in San Diego, California.

More information: The poster, "Effect of PTFE Particle on Super-Hydrophobic Coating for Anti-Icing" will be discussed at 5:50 p.m. on Sunday, Nov. 18 in Ballroom 20D Foyer. Abstract: meeting.aps.org/Meeting/DFD12/Event/177678

Provided by American Institute of Physics