Not so easy to imitate nature

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The idea was to solve the problem of de-icing airplane wings. But the result of the research project at Linköping University in Sweden was just the opposite: the possibility of artificially freezing ice at high temperatures.

Biomimetics is the science that tries to imitate nature's solutions to various problems. One approach is to apply biological principles to the construction of new products, another to copy molecular building blocks for new purposes.

Researchers at the Section for Molecular Physics at Linköping University in Sweden got interested in proteins that exist in fish in polar areas, such as flounders, in order to keep their blood from freezing. Arctic sea water can reach -2 degrees centigrade, a temperature where normal fish would freeze to death.

Doctoral student Annika Borgh started a project to try to utilize properties of these anti-freeze proteins, which exist in two forms: with and without a sugar group attached. The proteins bind to the surface of tiny 'ice embryos' and prevent the formation of ice crystals.

In the fish, the protein is loose in the blood, but Annika Borgh wanted to have them on a surface, such as on an airplane wing, where they might be able to prevent the formation of ice, which is a huge problem at airports in winter. But the proteins don't like being on surfaces, so she developed molecules with sugar and methyl groups, though without the protein skeleton as such. These were applied to a plate with a surface of

gold, where they organized themselves in a so-called monolayer.

Water was condensed on the surface, and the plate was chilled. The surprising result was that the water froze at a higher temperature when there were anti-freeze molecules on the surface than when they weren't there.

"The anti-freeze protein probably functions only in solutions, where it can prevent ice embryos from forming from all directions. Instead, we should be able to make use of the reverse effect, to freeze ice rinks using less energy, for instance, or perhaps to develop a polymer with these properties that can be painted onto a surface," says Annika Borgh.

Source: The Swedish Research Council