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Sharkskin Technology: Improved aerodynamics in aviation

In a joint project, BASF and Lufthansa Technik have succeeded in developing a functional film that mimics the fine structure of a shark's skin and thus optimizes aerodynamics at flow-relevant parts of the aircraft. As a result, fuel consumption and thus CO_2 emissions can be reduced.

The surface structure, which consists of riblets around 50 micrometers in size, imitates the properties of a shark's skin. Covering the flow-relevant areas of the aircraft with the functional film NovaFlex SharkSkin reduces drag by around 1 percent, which in turn saves around 400 tons of kerosene and around 1,250 tons of CO_2 per aircraft (long-haul passenger aircraft of the type Boeing 777-300ER) per year. Lufthansa Technik and BASF intend to systematically develop the new technology in the direction of additional aircraft types and even larger areas, so that it can support airlines around the world even more comprehensively in achieving their emission targets in the future. In initial model calculations, the sharkskin technology could even avoid CO_2 emissions of up to three percent in its maximum expansion stage.

For further information:

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(01) Report
(05‘25 / Mix / Report)

Better aerodynamics, less kerosene, less CO_2
Sharkskin Technology for Aviation

TC: 00:08:00
Speaker
An airplane hangar in Frankfurt am Main.
This airplane is covered with a functional film. But this is not for decoration…

TC: 00:18:00
Laura-Jane Mehnert, BASF
We are here in the Lufthansa Technik hangar at the Boeing 777F. Today, we are applying our sharkskin film, which functions to reduce drag.

TC: 00:28:00
Speaker
Shark skin? But sharks live in the water. What does that have to do with airplanes? The best place to find out is where the high-tech film was developed:
BASF's Coatings division in Münster, North Rhine-Westphalia.
Sebastian Hartwig is the team leader and explains how it works:

TC: 00:52:00
Sebastian Hartwig, BASF
The idea for NovaFlex SharkSkin derives from nature – or more precisely from sharks. Sharks are known as very efficient swimmers. This is because they have a special surface structure on their skin.

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In addition to its scales, it has a certain groove-like structure, known as a riblet structure. This ensures that the shark can reduce its drag and can therefore swim so efficiently.

TC: 01:15:00
Speaker
Sharks are really smart.
Together with Lufthansa Technik, these properties were transferred and certified for use on aircraft. Every detail was first computer simulated:

TC: 01:30:00
Olivia Vanmarcke, Lufthansa Technik
An output of our simulations regarding the design was how the flow runs locally on the fuselage. This information helps us make our cutting plan – in other words, in which orientation we attach the individual riblet film patches onto the fuselage.

The drag reduction and thus the fuel and CO_2 savings achieved by the entire modification are simulated here, as well.

TC: 01:59:00
Jens-Uwe Müller, Lufthansa Technik
We are now saving about 1% of fuel with the film. That means over 300 tons of kerosene and almost 1000 tons of CO_2 per aircraft.

With the fuel that Lufthansa Cargo will save when the fleet is equipped, you can fly around the equator eleven times – based on average consumption.
That's quite a distance.

TC: 02:21:00
Speaker
Back to Münster and the production of NovaFlex SharkSkin riblet film.

The fine wave pattern is applied to a carrier material. How exactly remains a company secret. A protective film is applied to the top and an adhesive film to the bottom, which is also protected by a film. And the sharkskin is ready for application.
But how does a company like BASF come up with an idea like sharkskin?
Uta Holzenkamp, head of BASF Coatings, knows the answer.

TC: 02:57:00
Uta Holzenkamp, BASF
We use all of our innovative power to develop solutions for a more sustainable future.

We do this with our customers.
We also want to help our customers achieve the goals of decarbonization or circularity.
That is why we are working very closely with our customers and other partners to address this major challenge of our time.

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TC: 03:24:00
Speaker
It was a long road before an aircraft equipped in this way was allowed to take off for the first time: because one thing is the production of the riblet film. It was another matter to ensure that it could resist the stresses to which it is exposed in the life of an aircraft over many years.
Will the film remain elastic enough to withstand the deformation of the aircraft body, such as during takeoff and landing, without damaging the riblets? Strong UV light high above the clouds should not affect the structure, nor should sand or dirt particles kicked up during landing.
If riblets work so well on airplanes, the question is whether there are other applications where riblets can add value.
The company Bionic Surface Technologies in Graz, Austria, is simulating this very precisely: What other applications could benefit from the riblet film?

TC: 04:30:00
Andreas Flanschger, bionic surface technologies GmbH
Riblets can be used effectively wherever there is turbulent flow.

You can imagine that this is almost everywhere in everyday life – such as in airplanes, pipelines, wind turbines, cars, motor sports or ships. So really any fluid, like water, gas, air, and so on.
Riblets can be used everywhere.

TC: 05:00:00
Speaker
Whether underwater, on a rotor blade, or high in the air, sharkskin is an example of how humans can use scientific methods and engineering skills to model nature. In this way, BASF is making an important contribution to the transformation of the industry.

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