

MATERIALS ENGINEERING

Extra toughness in the air

Unprecedented product gives more resistance to the wingtip lights of Embraer's aircraft

YURI VASCONCELOS

Published in March 2003



Legacy: innovation being tested on the wingtips

A technological innovation developed by a group of researchers from the University of São Paulo (USP) should assist Embraer in its project for nationalizing the parts and components used in the making of its regional and executive jets. This is a thin film of silicon nitride, that applied to the protective case of an aircraft's navigation lights, makes the part much tougher and resistant to wear and tear. These lights, located on the wingtips (red on the left wing and green on the right one) serve as visual orientation for other pilots, as to the aircraft's flight path – whether it is moving away or coming closer to the observer. The outer coating makes the lenses - usually made of polycarbonate, a kind of plastic very close to acrylic - support the strong attrition to which they are subjected during flight. The microabrasion generated by the friction of particles in suspension with the lenses jeopardizes their efficiency in illuminating. Embraer currently imports this part from a manufacturer in France.

The development of the product is the result of years of research by Professor Luiz Gonçalves Neto, from USP's São Carlos Engineering School, Professor Ronaldo Mansano and researcher Luís da Silva Zambom, both from the Electronic Systems Engineering Department, of USP's Polytechnic School in São Paulo. The three of them, plus colleagues Patrick Verdonck and Giuseppe Antônio Cirino, also from the Polytechnic School, had already developed and patented, with assistance from FAPESP, a carbon film known by the acronym DLC (for Diamond-Like Carbon), also used for the external coating of surfaces.

The great advantage of the lenses covered with the silicon nitride film is its toughness. "In the tests carried out in the laboratory, in which the surface of the parts is scratched with a diamond bit, we found that the lens covered with silicon nitride is about twice as tough as the lights that equip the company's jets today. We believe that the working life of the lenses will be far longer than that of the conventional

lights, which is about two years", Professor Mansano explains. One benefit arising from the increased durability is a reduction in the aircraft's maintenance time. Another advantage, the researchers claim, is the low cost of the product. "We do not yet have the final amount, but we believe that it will be far lower than that of the part that is being used by Embraer", he says. "Not to mention that, with our film, Embraer will no longer depend on importing the light from France".

Ample cover - According to the researchers, the two main problems that arose in the course of the development of the process – the adherence of the film to the polymeric material and the uniformity of deposition – have now been solved. "We carried out mechanical and optical tests that proved that the adherence of the silicon nitride film to the surface is in accordance with the parameters of the aeronautical industry", Luiz Gonçalves Neto explains. The scientists believe that the film may be used to cover other components of the air-



PHOTOGRAPH BY EDUARDO CESAR

craft, besides the wingtip lenses, such as the windows, windscreen and external lights. It may also have a military application, covering the optic windows of missiles. “We are very optimistic”, says Professor Luiz Gonçalves. “We intend to get the patenting process under way before the end of the year.”

Tests in flight - A model of the lens coated with silicon nitride has been under test since January, in a prototype of the Legacy executive jet, Embraer’s newest aircraft, launched last year. The tests are run by the company’s technological development management. “It is still too soon to say anything about the results of these tests. We hope to conclude them by the end of the first half of this year,” explains materials engineer Ricardo Bou Reslan Calumbly, who is responsible for the tests with USP’s lens. Embraer’s interest in the technological innovation was due to the fact that some of the French lenses that currently equip the Legacy have proved to turn opaque prematurely. We have had complaints and we saw that some of

these lenses showed a certain wear and tear during the flight or certification tests”, explains Embraer’s materials engineer Isabella Emmerick, who participates in the test team.

The Legacy is a medium sized executive jet, inspired on the platform for the ERJ 135/140/145 regional aircraft, which has over 600 units flying. It is available in two versions: Executive and Shuttle, with a capacity for up to 19 passengers. The jet is capable of flying some 5,700 kilometers without needed to refuel – the distance between London and New York, for example. The jet was launched in 2001 and certified to fly by the American and European aeronautical authorities at the end of last year. Embraer has now delivered 15 units and received 164 orders for the plane from customers from several countries.

The demand from the aircraft manufacturer in São José dos Campos for the Legacy’s wing tip navigation lights is small, a mere 50 units a year. To cater for Embraer, assuming the part is approved in the tests currently under way, the researchers plan to set up a small

company in a technology-based incubator. “Besides equipping the Legacy, we are going to offer the product for the company’s other jets and to Brazilian airlines, which need to have the part in their workshops for the maintenance of the aircraft”, says Gonçalves Neto.

Other applications - To allow silicon nitride film to be produced on a large scale, the scientists are thinking of other applications outside the aeronautical sector. One alternative is covering car headlights with the product. “In the future, we can hand over this technology to the automobile industry”, explains Mansano. The product can also be used to coat polycarbonate lenses in glasses, which are much lighter than glass lenses, but have the disadvantage of scratching very easily. “We are now in contact with some manufacturers, who have shown interest in the product”. Besides protecting the lenses against scratching, the film works like an optic filter and esthetic covering, as their color can vary in accordance with the thickness of the film.