

Passive anti-icing systems: icephobic coating for aeronautical applications

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The ice formation on a critical components such as wings and vertical tails is the main problem for the reliability and safety for aircraft flights. Passive anti-icing protections such as superhydrophobic and icephobic coatings, are potentially employed to prevent the ice adhesion and its growth.

Actually to obtain icephobic aircraft surfaces, it is necessary to apply a coating (permanent or not) that cover and mask the livery coating in contrast with the aesthetical properties of the aircraft.

The aim of this work is to develop an icephobic coating with the same aesthetical properties to the classical commercial coating used as a livery. Starting from a commercial livery coating, a new formulation was developed combining both icephobic and aesthetical properties.

In this work will be described the progress in aesthetical anti-icing coating development, starting from the basic theories of the adhesion phenomena between supercooled water droplets and surfaces (TRL1) to the design and testing of the new multifunctional aeronautical coating in relevant environment (TRL5).

In fact the best formulation and architecture of the coating system was characterized at lab scale in order to evaluate icephobic properties using a new tool mounted on classical contact angle measurement apparatus that allows reproducing the flight condition of pressure and temperature values in which there is the highest risk of icing.

Electron Scanning Microscopy and confocal profilometry were applied in order to characterize the surface morphology of the new multifunctional coating. Nanoindentation, cutting and tape test and pull-off test were carried out to evaluate the mechanical properties of coating. Moreover, the coating was treated with Skydrol in order to test its resistance to a common aviation hydraulic fluid.

Finally, a successful validation of icephobic properties of the new multifunctional coating was achieved testing it in a Icing Wind Tunnel. In fact two NACA 00015 airfoils were design and realized in ABS using Additive Layer Manufacturing and subsequently they were coated with the classical aeronautical coating and with the new multifunctional coating.

Results show a drastic reduction of the ice growth on surfaces covered with the new multifunctional coating respect to the commercial one.