

Anti-ice coatings for aeronautical application: new methodologies for characterization

L. Mazzola, C. Ascione, M.V. Fiocca

Italian Aerospace Research Centre (CIRA)

Via Maiorise 1, 81043, Capua, Italy

* Author to whom correspondence should be addressed. E-mail: l.mazzola@cira.it, phone: +39

0823623153, fax: +39 0823623132

Abstract

The main problem for the aircrafts is the ice formation on critical components (leading edge, slat, vertical tails, etc...) that decrease reliability and safety of the flights. Present methods that prevent or oppose ice nucleation and growth are not effective and several studies are on going.

Passive methods such as superhydrophobic and anti-icing coatings, could be potentially employed to prevent ice adhesion.

The aim of this work is to design and characterize multifunctional aeronautical coatings with anti-ice properties, high adhesion and abrasion resistance. The new anti-ice coating was developed starting from waterbased polyurethane resin employed and certified for aeronautic field. This base formulation was modified with silica nanoparticles in order to give the new anti-ice properties.

For evaluation of anti-ice properties, a new way to characterize these coatings was developed. In order to evaluate the adhesion between the supercooled water droplet and surface, the chemical and physical properties of the surface was determined. In particular two performance indexes are taken into account: wettability and surface free energy.

Surface Free Energy and wettability are two properties that depend both on the chemical state and roughness of the surface material.

The characterization of anti-ice properties of coatings were carried out through contact angle measurements technique. Tests were carried out in order to evaluate the interaction between the supercooled water droplet and surfaces in simulated environment in order to create the same flight conditions (both of temperature and of pressure).

In this work is shown the influence of temperature and in particular of pressure on the shape of the supercooled water droplet. It is also shown that a surface apparently superhydrophobic below zero degree and with pressure value at sea level, in real conditions of flight, is partially hydrophobic. In fact, at a certain altitude of flight, temperature is under zero degree and pressure values are reduced. Finally mechanical tests were carried out to determine the main properties of the coatings.

Keywords: surface free energy, nanostructured surfaces, anti-ice coatings, silica nanoparticles, non-wettable surface