Icephobic nanocomposites for aeronautics

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Ice Protection Systems (IPS) are remarkable and essential parts of aircrafts since the formation of ice undergone in extremely hard conditions could give rise to the lack of the controllability of the aircraft. Traditional deicing systems suppose expensive and complicated systems that demand a very careful maintenance [1]. Moreover, the complexity of some of these systems makes them difficult to accommodate in small-medium aircraft. The need of seeking new systems with advantages like costs, low power consumption, reparability and lightness entails a relevant challenge.
In this regard, different coatings based on nanocomposites have been developed as passive systems against ice formation [2]. The basis of these coatings is the additivation of a hydrophobic matrix (silicones) with inorganic nanoparticles creating a controlled microroughness in the surface responsible of the icephobic behavior of the final coating. The main features to control during the process are on one side, the dispersion of the inorganic nanoparticles and on the second hand the final roughness. For the first aim, the inorganic particles were dispersed ultrasonically using high surface particles to improve the final dispersability in the organic matrix and also the final concentration was adjusted to obtain an enough microroughness for the accomplishment of a superhydrophobic coating keeping a good final adherence of the coating.
Several coatings based on nanocomposites with silicone and fluorosilicone reinforced with high surface alumina nanoparticles were prepared onto Al6061 substrates with different concentration of particles. The final adherence was optimized through different chemical and physical approaches obtaining as result a better adherence after the imprimation of the bare substrate and the subsequent use of an anchoring coating. The measurement of contact angle, roughness, ice formation, ice adherence and resistance to erosion were some of the characterization measurements carried out for the different coatings. Good adherence, contact angles within the range of 110-150° were obtained depending on the final additive concentration, improvement of the erosion resistance and lower ice formation comparing with other hydrophobic materials were some of the features of the developed materials, revealing these coatings as a promising alternative to other conventional IPS.

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References

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