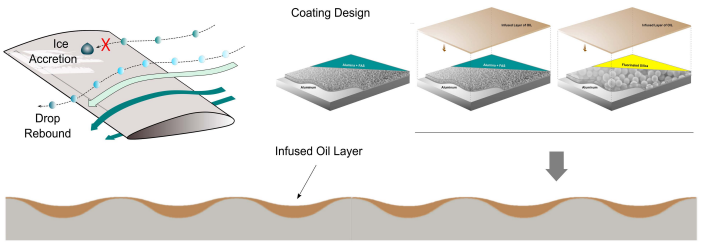
Icephobic properties of anti-wetting slippery liquid-infused porous ceramic coatings for aeronautical applications

A. Corozzi, M. Caruso, G. Guarini, M. Raimondo

Consiglio Nazionale delle Ricerche – Istituto di Scienza, Tecnologia e Sostenibilità per lo Sviluppo dei Materiali Ceramici (CNR – ISSMC), Via Granarolo, 64, Faenza, 48018 Italy

alessandro.corozzi@issmc.cnr.it

The formation and following accretion of different forms of ice poses serious safety and operational challenges in wind farms and airplanes, high voltage power lines, telecommunication systems, condenser surfaces, offshore platforms, locks, and dams. Intense efforts are therefore dedicated to developing passive ice protection systems (IPS) that can control or prevent ice formation. Anti-wetting materials applied on the target surface have been explored as potential ice-phobic surfaces [1], with the Slippery, Liquid-Infused Porous Surfaces approach (SLIPS) being one of the most innovative and intriguing possible solutions to inhibit ice accretion or weaken the ice adhesion strength without any power supply [2]. This study presents the design of anti-wetting hybrid SLIPS coatings for cold environments that comprise an inorganic, porous ceramic scaffold with grafted fluoroalkyl silane molecules infused with a lubricant polymer. The reduction of ice adhesion was determined with the Double Lap Shear Test, while the dynamic behavior of droplets was evaluated via goniometric contact angle hysteresis calculation, at both room and sub-zero temperatures [3, 4].
The modeling of the different icing phenomena that happen on the proposed air intake, dedicated testing methodologies have been developed: *i)* direct impingement of supercooled droplets through an icing wind tunnel located in a cold climate chamber, and *ii)* running wet icing in which there is a water flow coming from an upstream heated area.



[1] A. J. Meuler, J. D. Smith, K. K. Varanasi, J. M. Mabry, G. H. McKinley, R. E. Cohen, ACS Applied Materials and Interfaces, **2**, 3100, (2012)
[2] S. B. Subramanyam, K. Rykaczewski, K. K. Varanasi, Langmuir, **29**, 13414 (2013)
[3] A. Corozzi, G. Boveri, F. Veronesi, M. Raimondo, Coatings, **11**, 77 (2021)
[4] F. Veronesi, G. Boveri, J. Mora, A. Corozzi, M. Raimondo, Surface & Coatings Technology, **421**,127363 (2021)