ANTI-ICING USING SMART MATERIAL IN AIRCRAFT

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Abstract- Ice-repellent coatings can have significant impact on the global energy saving and improving safety in many infrastructures, transportation. Recent efforts for developing ice-phobic surfaces have been mostly devoted to utilize lotus leaf-inspired superhydrophobic surfaces, yet these surfaces fail in high humidity conditions due to water condensation and frost formation and even lead to increased ice adhesion due to a large surface area. We are going to present a radically different type of ice-repellent material based on Slippery, Liquid-Infused Porous Surfaces (SLIPS), where an ultrasmooth and slippery liquid interface is maintained by infusing a water-immiscible liquid into a nanostructured surface. We develop a direct method of SLIPS on industrially relevant metals, particularly aluminum-allow, one of the most widely used materials as lightweight structural materials for aircraft, marine vessels, and construction materials. SLIPS-coated Al surfaces not only suppress ice/frost accretion by effectively removing condensed moisture even in high humidity conditions, but also exhibit at least an order of magnitude lower ice adhesion than state of the-art materials. Based on a theoretical analysis followed by extensive icing/deicing experiments, we discuss special advantages of SLIPS as ice-repellent surfaces. We show report that our surfaces remain essentially frost-free even in high humidity conditions, in which any conventional materials accumulate ice. These results indicate that SLIPS is a promising candidate for developing robust anti-icing materials for broad applications in aircraft industries ,marine industries and auto-mobile industries

Key Words- Anti-frost surfaces, Nanostructure coating, slippery liquid-infused porous surface, electro-deposition.

I. INDRODUCTION

Ice formation and accretion present serious economic and safety issues for many essential infrastructures such as aircraft, fuel system, turbines, and communications equipment. Using heat exchangers and other melting sources has become low cost effective and weight consuming. .

To overcome this we are going to develope the composite material to act as the anti-icing material During the past decade, progress has been made towards understanding the use of lotus leaf-inspired superhydrophobic surfaces for the prevention of ice formation .Under a frost-free environment (e.g., low humidity conditions), superhydrophobic surfaces show promising behavior in preventing ice formation2, even at temperatures as low as -25 to -30°C.

II. PROBLEMS DUE TO THE FORMATION OF ICE IN AIRCRAFT STRUCTURE

There are three varieties of ice in aircraft 1.Rime 2.Glaze 3.mixed. Rime is a hard white ice formed of frost and mist. Rime ice can accumulate on the leading edges and control surfaces of aircraft operating in certain meteorological conditions. Glaze ice or simply glaze' is a smooth, transparent and homogeneous ice coating occurring when freezing rain or drizzle hits a surface.[2]

It is similar in appearance to clear ice, which forms from supercooled water droplets. It is a relatively common occurrence in temperate climates in the winter when precipitation forms in warm air aloft and falls into below-freezing temperature at the surface.

III. ICE REMOVAL TECHNIQUES

Anti-icing

Heated wings-Hot compressor bleed air is directed into sections of the wing increasing its surface temperature. Weeping wings-Fluid (a water and glycol mix) is pumped through a mesh panel on the wings leading edge. Clean wings can also be sprayed with glycol based fluids to protect against freezing for a limited time.

Deicing:

Pneumatic boots-attached to wings and are inflated with air in order to break off any ice that has accumulated on them. If wings have accumulated ice, a heated glycol and water mix is sprayed on the wings to remove it

IV. DRAWBACKS IN EXISTING METHODS

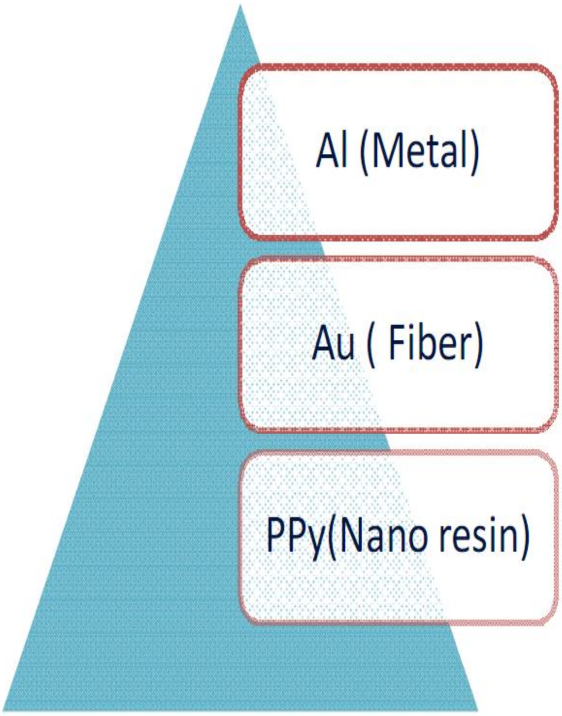
- Complicated construction
- Increase weight of the aircraft
- Maintenance cost
- Difficulty during maneuvering

V. THOUGHT TO OVERCOME THE EXISTING METHOD

We report a radically different type of ice-repellent material based on slippery, liquid-infused porous surfaces (SLIPS) It is an ultra-smooth and slippery liquid interface and is maintained by infusing a water immiscible liquid into a nanostructure surface. SLIPS-coated Al surfaces not only suppress ice/frost accretion by effectively removing condensed moisture even in high humidity conditions. Particularly significant for anti-icing technologies is the development of ice- and frost-free aluminum surfaces, as Al is one of the most widely used metal as cooling fins in heat exchangers and lightweight structural materials for aircrafts, marine vessels, and construction industry. Here we develop Al-based material that satisfies these criteria by electro deposition of highly textured polypyrrole (PPy) on Al substrates followed by fluorination of the structured coating and infiltration with the lubricant.

VI. METHOD TO FORM OF SLIPS

The flow chart describe the composition of the material in SLIPS .In that aluminium (Al) alloy is metal, in which matrix and fiber is coated. Gold and Silver is a fiber polypryl (Ply)is a matrix.



VII. ELECTRO-DEPOSITION

The Ply-coated aluminum samples were placed in a desiccator with (tridecafluoro-1,1,2,2-tetrahydrooctyl) trichlorosilane (Gelest) for 48 hrs under vacuum to render the surfaces hydrophobic. We then covered the hydrophobized PPy-coated aluminum samples by applying droplets of a perfluorinated lubricant, perfluoroalkylether (Krytox 100, immiscible with most polar and nonpolar liquids; chemically stable;

wide operation temperature range, very low freezing point (<-70°C), DuPont), then stood the samples vertically to remove excess lubricant until no macroscopic movement of lubricant on the surface was evident. Lubricated aluminum surfaces (K100-Al and K100 F13-Al) were also prepared using the same method. We estimated the thickness of the lubricating layer to be 8-10 µm based on the measured weight change, substrate size, and the density of the lubricating liquid.

CONCLUSION

The key in achieving this property is to create a lubricating film that overcoats the solid support whose function is to stabilize and hold the lubricant in place. As a result, water droplets that condense on such an interface are not exposed to the underlying solid defect sites and are capable of sliding off the surface at very low tilt angles. SLIPS can effectively delay ice accumulation and facilitate removal of ice even under high humidity conditions. These results indicate that SLIPS is a promising candidate for developing robust anti-icing materials.

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