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Hydrophobic / icephobic coatings based on thermal sprayed metallic layers with subsequent surface functionalization

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Abstract

Hydrophobic / icephobic coatings have been fabricated using a combination of thermal sprayed metallic MCrAlY (M = Ni, Co) coatings with a subsequent deposition process using 1H,1H,2H,2H-perfluorooctyltriethoxysilane (POTS). The MCrAlY coatings provide the desirable surface roughness feature for hydrophobicity, and water contact angle of 135° was directly obtained after aged in the atmosphere for 1 week. However, it was found that the hydrophobicity of MCrAlY was not stable under water impinging due to unstable hydrocarbon absorption. Better hydrophobicity with water contact angle of 154° and improved durability have been achieved by further modification using POTS vapour on the rough MCrAlY coatings. X-ray photoelectron spectroscopy results revealed that replacement of absorption of hydrocarbon by functional C-F groups played important role in the improvement of hydrophobicity and durability. The ice adhesion test confirmed that lower ice adhesion strength of MCrAlY based coatings have been obtained compared with the threshold for icephobicity which is desirable to be applied as icephobic coatings for aircraft. The electro-thermal heating de-icing test showed an energy saving of 28.6% for de-icing with the two-step MCrAlY based coatings. The combination of strong metallic MCrAlY rough layers