PIEZOELECTRIC BASED ICE PROTECTION SYSTEM – MODELLING AND EXPERIMENTAL RESULTS

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Ice accretion on aircraft structure is a critical issue in terms of safety and energy consumption. The presence of ice disturbs the aerodynamic around the wing, leading to decrease in lift and increase in drag forces, as well as potentially damaging external equipment such as antennas.

Therefore, Ice Protection Systems (IPS) are crucial, being one of the major safety ensuring system on board. Current ice protection technologies have important drawbacks due to weight, power consumption and incompatible integration with certain structures. In addition, increasing demands upon the aviation Industry to reduce emissions and associated net passenger mile costs are forcing designers of new aircraft to turn their attention towards more-electric aircraft (MEA) solutions. An increasing interest towards alternative electrically based technologies for IPS is expected. Whilst large airframes have the capacity to generate significant levels of electrical power, compatible with power requirement of electro-thermal de-icing systems, this is not the case on smaller airframes such as business jets. Low electrical power concepts such as Electro-Expulsive (EEDI) and Impulsive (EIDI) do not provide sufficient reliability and are not compatible with the current aerofoil structure.

The present work focused on the development of an alternative low-power solution based on the piezoelectric effect, compatible with small airframes. Prototypes of piezo-based IPS were fabricated with simplified aerofoil structure and tested in a simplified ice-wind tunnel system developed internally, along with extensive FEM modelling to evaluate the level of shear stresses at the leading edge and de-icing performance. Finally, successful de-icing of two different types of ice (rime ice and clear ice) has been experimentally demonstrated.

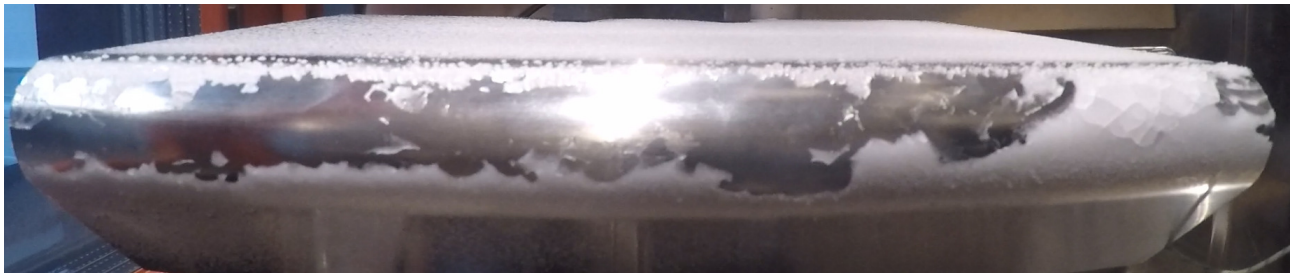

Figure 1: Picture of aerofoil showing the results of the piezoelectric based IPS.