Proceedings of the 10th International Conference on Fluid Flow, Heat and Mass Transfer (FFHMT'23)
Canada – June 07-09, 2023
DOI: 10.11159/ffhmt23.002

Aircraft/Aeroengine Icing Physics and Innovative Strategies for Inflight Icing Mitigation

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Aircraft/Aero-engine icing is widely recognized as a significant hazard to aircraft operations in cold weather. The speak will introduce his recent research in conducting a comprehensive experimental campaign to elucidate the underlying aircraft/aeroengine icing physics. By leveraging the unique Icing Research Tunnel available at Iowa State University (i.e., ISU-IRT), comprehensive investigations are conducted to examine the important micro-physical processes pertinent to aircraft/aeroengine icing phenomena. A suite of advanced flow diagnostic techniques, including molecular tagging velocimetry and thermometry (MTV&T), digital image projection (DIP), and high-speed infrared (IR) imaging thermometry techniques, are developed and applied to quantify water droplet impinging dynamics, transient behaviors of wind-driven water runback flows, unsteady heat transfer and dynamic solidification processes over airfoil/wing surfaces. Anti-/de-icing performances of various "state-of-the-art" hydro-/ice-phobic coatings/surfaces, including a lotus-inspired superhydrophobic surface (SHS) and a pitcher-plant-inspired Slippery Liquid-Infused Porous Surfaces (SLIPS), are evaluated quantitatively under different icing conditions (i.e., ranged from dry rime icing to wet glaze icing conditions). The recent research efforts on unmanned-aerial-system (UAS) icing will also be introduced briefly. The findings derived from the icing physics studies are extremely helpful to improve current icing accretion models and to develop novel, effective anti-/de-icing strategies to ensure safer and more efficient operation of aircraft/aeroengined in