Abstract Submitted
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Wind Turbine Icing Physics and A Novel Strategy for Wind Turbine Icing Mitigation[1] LINYUE GAO, HUI HU, Iowa State University — Wind turbine icing represents the most significant threat to the integrity of wind turbines in cold weather. By leveraging the Icing Research Tunnel available at Iowa State University (ISU-IRT), an experimental study was conducted to elucidate the underlying physics of the important micro-physical processes pertinent to wind turbine phenomena and explore novel anti-/de-icing strategies for wind turbine icing mitigation. A suite of advanced flow diagnostic techniques, which include molecular tagging velocimetry and thermometry (MTV&T), digital image projection (DIP), and infrared (IR) imaging thermometry, were developed and applied to quantify the transient behavior of wind-driven surface water film/rivulet flows, unsteady heat transfer and dynamic ice accreting process over the surfaces of wind turbine blade models. A novel, hybrid anti-/de-icing strategy that combines minimized electro-heating at the blade leading edge and an ice-phobic coating to cover the blade surface was developed for wind turbine icing mitigation. In comparison to the conventional strategy to brutally heating the mass blade surface to keep the blade ice free, the hybrid strategy was demonstrated to be able to achieve the same anti-/de-icing performance with substantially less power consumption (i.e., up to ˜90% power saving).

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