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Delayed frost formation on hybrid nanostructured surfaces with patterned high wetting contrast YOUMIN HOU, PENG ZHOU, SHUHUAI YAO, Department of Mechanical and Aerospace Engineering, The Hong Kong University of Science and Technology, Hong Kong — Engineering icephobic surfaces that can retard the frost formation and accumulation are important to vehicles, wind turbines, power lines, and HVAC systems. For condensation frosting, superhydrophobic surfaces promote self-removal of condensed droplets before freezing and consequently delay the frost growth. However, a small thermal fluctuation may lead to a Cassie-to-Wenzel transition, and thus dramatically enhance the frost formation and adhesion. In this work, we investigated the heterogeneous ice nucleation on hybrid nanostructured surfaces with patterned high wetting contrast. By judiciously introducing hydrophilic micro-patches into superhydrophobic nanostructured surface, we demonstrated that such a novel hybrid structure can efficiently defer the ice nucleation as compared to a superhydrophobic surface with nanostructures only. We observed efficient droplet jumping and higher coverage of droplets with diameter smaller than 10 μm, both of which suppress frost formation. The hybrid surface avoids the formation of liquid-bridges for Cassie-to-Wenzel transition, therefore eliminating the 'bottom-up' droplet freezing from the cold substrate. These findings provide new insights to improve anti-frosting and anti-icing by using heterogeneous wettability in multiscale structures

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