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Passive anti-frosting surfaces using microscopic ice arrays. FARZAD AHMADI, SAURABH NATH, GRADY ILIFF, JONATHAN BOREYKO, Virginia Tech — Despite exceptional advances in surface chemistry and micro/nanofabrication, no engineered surface has been able to passively suppress the in-plane growth of frost occurring in humid, subfreezing environments. Motivated by this, and inspired by the fact that ice itself can evaporate nearby liquid water droplets, we present a passive anti-frosting surface in which the majority of the surface remains dry indefinitely. We fabricated an aluminum surface exhibiting an array of small metallic fins, where a wicking micro-groove was laser-cut along the top of each fin to produce elevated water "stripes" that freeze into ice. As the saturation vapor pressure of ice is less than that of supercooled liquid water, the ice stripes serve as overlapping humidity sinks that siphon all nearby moisture from the air and prevent condensation and frost from forming anywhere else on the surface. Our experimental results show that regions between stripes remain dry even after 24 hours of operation under humid and supercooled conditions. We believe that the presented anti-frosting technology has the potential to help solve the world's multi-billion dollar frosting problem that adversely affects transportation, power generation, and HVAC systems.

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