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Structured surfaces for anti-frosting

We here present hydrophobic surfaces designed to delay frosting passively.
Hydrophobic structured surfaces showing coalescence induced condensation droplet jumping (CICDJ) are known to slow down frosting because of unsuccessful ice-bridging events. In a previous study we reported a kind of surfaces structured with truncated microcones covered by uniformly hydrophobic nanostructures that enable single droplet self-ejection [1]. The anti-frosting effect is improved because almost all the droplets self-eject at a precise size and all the ice-bridges are frustrated [2]. We here present these surfaces behavior under different surface temperatures (T) and air relative humidity. Higher supersaturation ratio (s) decreases the mean distance between the droplets (l). The droplet distance and diameter distributions vary with s and affect the ice-bridging parameter distribution thus frosting velocity. In particular, we analyze the regime change when l ⊠ of the cones unit cell size and the CICDJ events prevail on the self-ejection ones. Understanding the effects of environmental conditions on jumping modes (single and multiple droplets) and frost propagation types could lead to an optimal design in terms of cones size and arrangement.

References:
[1] N. G. Di Novo, A. Bagolini, N. M. Pugno. Single Condensation Droplet Self-Ejection from Divergent Structures with Uniform Wettability. ACS Nano 2024 18 (12), 8626-8640.
[2] N. G. Di Novo, A. Bagolini, N. M. Pugno. Ice-Bridging Frustration by Self-Ejection of Single Droplets Results in Superior Anti-Frosting Surfaces. Adv. Mater. Interfaces 2024, 11, 2300759.

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