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Transparent photothermal metasurfaces amplifying superhydrophobicity by absorbing sunlight EFSTRATIOS MITRIDIS, HENRY LAMBLEY, SVEN TRBER, THOMAS SCHUTZIUS, DIMOS POULIKAKOS, Mechanical and Process Engineering, ETH Zurich, LTNT TEAM — Designing robust superhydrophobic surfaces has received significant attention in the last decade, empowered by advancements in surface micro/nanoengineering. Researchers have investigated the effect of temperature on droplet-superhydrophobic surface interactions, which poses additional challenges when liquid nucleation manifests itself, due to ensuing surface condensation compromising its anti-wetting behavior. The few existing solutions fail to prevent condensation nucleation, which limits their working envelope, and are not engineered for applications requiring visible transparency. Here we employ and explore the working limits of plasmonic photothermal metasurface composites harvesting sunlight that can sustain water repellency and transparency under challenging environmental conditions where condensation would otherwise be strongly promoted. We demonstrate that a dramatic increase in microtexture filling time with light-induced heating prevents impalement of impacting droplets even for droplet-surface temperature differences of 50 degC. We also evidence how our metasurface works in symbiosis with nanotexture to offset inherent undesirable nucleation, which causes failure under moderate supersaturation conditions, for enhanced impalement resistance.

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