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Jumping-Droplet-Enhanced Condensation on Scalable Superhydrophobic Nanostructured Surfaces NENAD MILJKOVIC, MIT, RYAN ENRIGHT, MIT, Stokes Institute, Bell Labs Ireland, YOUNGSUK NAM, MIT, Kyung Hee University, KEN LOPEZ, MIT, Stanford University, NICHOLAS DOU, MIT, Caltech, JEAN SACK, EVELYN WANG, MIT — When droplets coalesce on a superhydrophobic nanostructured surface, the resulting droplet can jump from the surface due to the release of excess surface energy. If designed properly, these superhydrophobic nanostructured surfaces can not only allow for easy droplet removal at micrometric length scales during condensation but promise to enhance heat transfer performance. However, the rationale for the design of an ideal nanostructured surface, as well as heat transfer experiments demonstrating the advantage of this jumping behavior are lacking. Here, we show that silanized copper oxide surfaces created via a simple fabrication method can achieve highly efficient jumping-droplet condensation heat transfer. We experimentally demonstrated a 25% higher overall heat flux and 30% higher condensation heat transfer coefficient compared to state-of-the-art hydrophobic condensing surfaces at low supersaturations. This work not only shows significant condensation heat transfer enhancement, but promises a low cost and scalable approach to increase efficiency for applications such as atmospheric water harvesting and dehumidification. Furthermore, the results offer insights and an avenue to achieve high flux superhydrophobic condensation.

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