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Durable Jumping Dropwise Condensation with Carbon Nanofiber Composites CHEUK WING EDMOND LAM, MATTEO DONATI, ATHANASIOS MILIONIS, ETH Zurich, CHANDER SHEKHAR SHARMA, Indian Institute of Technology Ropar, ABINASH TRIPATHY, ARMEND ZENDELI, DIMOS POULIKAKOS, ETH Zurich — Metals are usually desired in heterogenous condensation of water due to their thermal and mechanical properties. However, their hydrophilic surfaces facilitate the formation of high-thermal-resistance condensate film known as filmwise condensation (FWC). Although the formation of such films can be suppressed by a hydrophobic layer so that water leaves as discrete droplets, i.e. dropwise condensation (DWC), the thickness of these organic layers required for robustness introduces additional thermal resistance. This challenge becomes even more apparent on less robust superhydrophobic surfaces, on which jumping dropwise condensation (JDWC) occurs. We present a facile method of preparing a thin (˜2 um) superhydrophobic polytetrafluoroethylene (PTFE) – carbon nanofiber (CNF) composite coating on copper, able to sustain JDWC for 10 h under flow condensation at 111 C steam flowing at 3 m/s, and an additional 50 h of DWC before FWC is observed. The estimated mean shear stress on the coating is >57 mPa, equivalent to a load of 94% of the coating's own mass. The robustness of the coating is provided by the CNFs, which simultaneously improve the composite thermal conductivity. We achieve a heat transfer coefficient improvement of up to 900% when compared to plain copper without modification.

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