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Dropwise Condensation Enhancement on Geometric Features YAJING ZHAO, DANIEL J. PRESTON, ZHENGMAO LU, EVELYN N. WANG, Massachusetts Inst of Tech-MIT — Dropwise condensation, which has been demonstrated to exhibit a 5-7X higher heat transfer coefficient compared with state-of-the-art filmwise condensation, contributes to energy savings in a wide range of applications such as desalination systems, steam cycles and dew harvesting. In order to enhance dropwise condensation performance, previous studies have investigated the effects of surface geometric features on droplet growth rates and found that bumps protruding from surfaces can effectively promote dropwise condensation. In this work, we show that while bumps on surfaces enable droplets to grow faster in some cases, there are also cases where bumps on surfaces actually degrade dropwise condensation. We numerically simulated and experimentally demonstrated that even the same surface geometric feature can exert completely opposite effects on dropwise condensation of water under two different working conditions (pure vapor vs. air vapor mixture). This phenomenon is explained by comparing the heat and mass transfer resistance of the surface structure to that of the vapor transport during dropwise condensation. We expect that the fundamental understanding developed in this study will provide useful guidelines for relevant condensation applications.

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