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Role of Nanostructure Coating Quality in Delay of Surface Flooding during Jumping Droplet Condensation DANIEL J PRESTON, DION ANTAO, MIT, NENAD MILJKOVIC, UIUC, BANAFSHEH BARABADI, JOHN QUEENEY, EVELYN WANG, MIT — Vapor condensation is commonly observed in everyday life and routinely used in industry as an effective means of transferring heat. In industrial systems, condensed vapor typically forms a thin liquid film which is not desired due to the large thermal resistance to heat transfer; however, if the condensing surface is functionalized with a hydrophobic coating, the condensate forms discrete liquid droplets which shed at sizes approaching the capillary length and refresh the surface for re-nucleation, resulting in a 5–7x heat transfer improvement. Furthermore, when a micro- or nanostructured surface is functionalized, a superhydrophobic surface can be created on which small (≈10-100 m) droplets coalesce and can spontaneously jump away from the surface due to release of excess surface energy; this jumping droplet mode of condensation has been shown to increase heat transfer by an additional 30 – 40%. However, at elevated supersaturations, nanostructured superhydrophobic surfaces can become flooded with condensate and form pinned droplets which cannot jump, thereby eliminating the desired heat transfer improvement. In this work, we experimentally demonstrated a delay in the supersaturation at which surface flooding occurs by reducing the hydrophobic coating defect density. This resulted in a lower proportion of structure unit cells occupied by condensate, which allowed higher droplet mobility and jumping at elevated supersaturation.

Daniel Preston
MIT

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