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Spatial Control of Condensation using Chemical Micropatterns KEVIN MURPHY, Virginia Tech, RYAN HANSEN, Oak Ridge National Labratory, SAURABH NATH, Virginia Tech, SCOTT RETTERER, PATRICK COLLIER, Oak Ridge National Labratory, JONATHAN BOREYKO, Virginia Tech, NATURE-INSPIRED FLUIDS AND INTERFACES TEAM, CENTER FOR NANOPHASE MATERIALS SCIENCES TEAM — Surfaces exhibiting wettability patterns can spatially control the nucleation of condensation to enable enhanced fog harvesting and phase-change heat transfer. To date, studies of patterned condensation have utilized a combination of chemical and topographical features, making it difficult to isolate the effects of intrinsic wettability versus surface roughness on spatially controlling the condensate. Here, we fabricate chemical micropatterns consisting of hydrophilic silicon oxide and a smooth hydrophobic silane monolayer to isolate the effects of changes in intrinsic wettability on the spatial control of condensation. Complete spatial control, defined as every nucleation and growth event occurring exclusively on the hydrophilic features, was observed even for supercooled droplets at high water vapor supersaturation. However, this complete spatial control was found to break down beyond a critical spacing that depended upon the extent of supersaturation. The average diameter of condensate was found to be smaller for the chemically micropatterned surfaces compared to a uniformly hydrophobic surface. Control of inter-droplet spacing between supercooled condensate through chemical patterning can be employed to minimize the growth of inter-droplet frost on cold surfaces.

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