Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Enhanced condensation heat transfer with wettability patterning PALLAB SINHA MAHAPATRA, ARITRA GHOSH, University of Illinois at Chicago, RANJAN GANGULY, Jadavpur University, CONSTANTINE MEGARIDIS, University of Illinois at Chicago — Condensation of water vapor on metal surfaces is useful for many engineering applications. A facile and scalable method is proposed for removing condensate from a vertical plate during dropwise condensation (DWC) in the presence of non-condensable gases (NCG). We use wettability-patterned superhydrophilic tracks (filmwise condensing domains) on a mirror-finish (hydrophilic) aluminum surface that promotes DWC. Tapered, horizontal "collection" tracks are laid to create a Laplace pressure driven flow, which collects condensate from the mirror-finish domains and sends it to vertical "drainage tracks" for gravity-induced shedding. An optimal design is achieved by changing the fractional area of superhydrophilic tracks with respect to the overall plate surface, and augmenting capillary-driven condensate-drainage by adjusting the track spatial layout. The design facilitates pump-less condensate drainage and enhances DWC heat transfer on the mirror-finish regions. The study highlights the relative influences of the promoting and retarding effects of dropwise and filmwise condensation zones on the overall heat transfer improvement on the substrate. The study demonstrated $\sim 34\%$ heat transfer improvement on Aluminum surface for the optimized design.

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Date submitted: 01 Aug 2015 Electronic form version 1.4