Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

Wicking in hierarchical surfaces: Micropattern governs the enhancement. ARIF ROKONI, DONG-OOK KIM, MIN PACK, YING SUN, Drexel University — Wicking in hierarchical surfaces has gained significant attention due to its potential applications in thermal management. Hierarchical surfaces have shown to enhance wicking over microstructured surfaces by some researchers, while others found very limited improvement. In this work, we demonstrate the importance of the micropatterns on wicking enhancement of hierarchical surfaces using ZnO nanorods grown on circular silicon micropillars of varying spacings and heights. The wicking front over hierarchical surfaces is found to follow a two-tiered motion, where wicking is faster while crossing the micropillars but slower while moving between micropillars. The former is driven by a stronger capillary force around the pillar perimeters and the latter by a weaker capillary force between pillars. The added capillary action due to nanorods is not significant when the wicking front moves across the pillars but plays an important role by altering the meniscus shape when wicking is between pillars. The competition between the added capillary action and viscous dissipation results in a critical micropillar diameter-to-spacing ratio, below which wicking enhancement due to nanostructures is more substantial. This new finding sheds light on more effective design of hierarchical surfaces for wicking enhancement.

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Date submitted: 01 Aug 2017 Electronic form version 1.4