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Dynamics of Wetting and Wicking on Rough Surfaces DION ANTAO, DANIEL PRESTON, SOLOMON ADERA, YANGYING ZHU, EVELYN WANG, Massachusetts Institute of Technology — Micro/nano engineering of surfaces to enhance the performance of phase-change heat transfer processes has recently gained wide interest. Interfacial phenomena at the micro/nanoscale play an important role in defining the dynamic wetting and wicking characteristics of the surfaces. Here we report experiments that characterize the dynamic wetting and wicking processes on microstructured silicon surfaces. We investigated cylindrical micropillar arrays in a square pattern with various diameter, pitch, and height to characterize key interfacial behavior over a wide range of surface roughness. The experiments were performed by dipping the microstructured sample vertically into a reservoir of de-ionized water and the spreading dynamics were captured with a high speed camera. We observed that both wetting and wicking exhibit a power law dependence on time, however they occur at different time scales. The instantaneous (˜10-100 ms) wetting behavior occurs due to the interfacial tensions, and the resultant force acting at the three-phase contact line. The longer time scale (>100 ms) wicking behavior results from the balance of the capillary pressure generated within the microstructure and the viscous pressure loss from flow through the micropillar array. We develop analytical models to predict these different time scale behavior and compare them to experimental results. This work provides insight into key dynamic processes affecting micro/nanostructure enhanced phase-change heat transfer devices.

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