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Capillary Surface in Micropillar Arrays ZHENGMAO LU, DANIEL PRESTON, DION ANTAO, YANGYING ZHU, EVELYN WANG, Massachusetts Inst of Tech-MIT — Many microfluidic and thermal management devices utilize microstructures for tuning surface wettability and capillary transport. Prediction of the liquid-gas interface shape within the microstructures can facilitate understanding of wetting regime transitions, liquid transport, and the criteria for liquid dry-out in such applications. We developed a theoretical model that directly solves for the interface shape in micropillar arrays as a function of the interfacial pressure difference. Our simulations indicate that three regimes exist as the interfacial pressure difference varies: (I) a fully pinned mode, (II) a partially receding mode where segments of the contact line recede while the rest is still pinned, and (III) a fully receding mode where the maximum interface curvature is reached. We observed all three regimes with water and silicon micropillar arrays using an environmental scanning electron microscope. We also compared results from our current method to the energy minimization approach using Surface Evolver simulations, which shows good agreement. This work offers fundamental insights into capillary surfaces in microstructures and assists in the design of micropillar-based superhydrophobic and microfluidic devices.

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