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Direct Observation of Hierarchical Contact Line Depinning
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We report a technique for observing the dynamic behavior of a liquid contact line at high magnification using environmental scanning electron microscopy. We find that on a superhydrophobic surface consisting of an array micropillars, the receding contact line exhibits discrete hierarchical de-pinning events. As the macroscopic contact line recedes across the pillars, a capillary bridge is formed and displays a local microscopic contact angle that is equivalent to the macroscale contact angle observed on a flat surface of the same composition. By considering the line density of the microscale features and the pinning strength of each of those features, we relate the macroscopic contact angle and adhesion to the multiscale hierarchical roughness. This mechanism helps to explain the necessity for multiple length scales exhibited by lotus leaves and other superhydrophobic surfaces.

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