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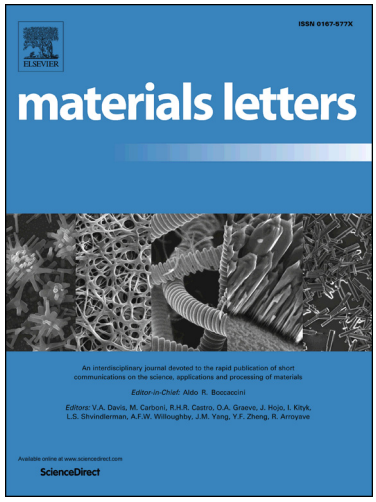


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# Gradient Wetting State for Droplet Transportation and Efficient Fog Harvest on Nanopillared Cicada Wing Surface

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ABSTRACT

As a result of natural selection, cicadas can easily remove water droplets, pollen or dust from their wing surface. A gradient wetting state along the wing veins is revealed for the first time in this work. That is, the Wenzel state (hydrophilic) is transformed to the Cassie-Baxter state (superhydrophobic) from foot to apex of the wing, which is attributed to different radius, height, and gap of the nanopillars on its surface. A fog harvesting test demonstrates that the cicada wing has a remarkable fog harvesting efficiency of 6.6 g $m^{-2}$ $s^{-1}$, which is comparable to the values reported for representative plant and animal surfaces. Superhydrophobic region exhibits a lower adhesion force to the droplets than hydrophilic region. So the accumulated droplets easily roll off from superhydrophobic to hydrophilic regions, and the light weight state on the wing can be maintained under its slight shaking. This work may direct the design of gradient wetting surfaces by mimicking the nanopillar structure of cicada wing and explore potential application in water harvesting.

**Keywords**: Cicada wing; Gradient wetting state; Fog harvesting; Nanostructured surface; Biomimetic; Functionality