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Wetting dynamics on asymmetric microstructured surfaces
SUSUMU YADA, SHERVIN BAGHERI, Department of Mechanics, KTH Royal Institute of Technology, JONAS HANSSON, Division of Micro and Nanosystems, KTH Royal Institute of Technology, MINH DO-QUANG, FREDRIK LUNDELL, Department of Mechanics, KTH Royal Institute of Technology, WOUTER VAN DER WIJNGAART, Division of Micro and Nanosystems, KTH Royal Institute of Technology, GUSTAV AMBERG, Sdertorn University — Microstructured surfaces which are able to control the direction of liquid transport are common in nature for fog/water harvesting, surface lubrication, and self-cleaning, and have been inspiring enormous number of man-made structures. However, the spreading of a liquid on such surfaces have been investigated in the slow spreading regime and a fundamental understanding of the early rapid wetting is lacking. In this work, our experimental and numerical investigations on surfaces with periodic patterns of asymmetric microridges provide detailed illustrations of the rapid droplet spreading over complex surface structures. We show that the surface structures are partly wetted as the air-liquid interface above the contact line makes another contact to the structure downstream and creates a new wetting front, leaving some dry surface behind. Furthermore, we elucidate how different physics play roles in different flow directions. In one direction, the spreading is governed by the friction at the moving contact line and the Young's force related to the local dynamic contact angle, whereas in the other direction, it is determined by the contact line pinning and the inertia of the droplet. Based on these physical insights, the effect of different surface geometry is discussed.

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