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Directional motion of evaporating droplets on gradient surfaces[1]
SHUHUAI YAO, LI XU, ZHIGANG LI, The Hong Kong University of Science and Technology — Droplet evaporation on surfaces has various applications in drying problems such as ink-jet printing, pesticide spraying, chemical or biological detection, and DNA microarray spotting technology. Controlling evaporating droplets via substrate morphology and/or wetting properties allows for efficient deposition of sample molecules in these applications. In this work, evaporation of sessile water droplets on surfaces with wettability gradients was studied. The wettability gradient was generated by fabricating non-uniformly distributed cylindrical micropillars on silicon surfaces. During the evaporation, it was found, along the wettability gradient, that the contact line on one side was strongly pinned, while the contact line on the other side depinned and gradually receded, making the center of mass of the droplet move either in or against the direction the wettability gradient, depending on the configuration of the micropillars. The theoretical criterion predicting the moving direction was derived based on the excess free energy and the energy barrier during the evaporation. The theoretical predications agreed well with the experimental observations. The results provide a parametric design basis to control the contact line dynamics and directional transport of evaporating droplets.

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