

Steering droplets on substrates with travelling wave wettability patterns and deformations

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Droplets are set in motion on substrates with a spatio-temporal wettability pattern as generated, for example, on light-switchable surfaces. To study such cases, we implement the boundary-element method to solve the governing Stokes equations for the fluid flow field inside and on the surface of a droplet and supplement it by Cox–Voinov friction for the dynamics of the contact line. One objective of our research is targeted microfluidic transport of such droplets. In earlier work we investigated how a droplet can be steered by imposing a wettability pattern on the substrate [Grawitter and Stark, *Soft Matter* **17**, 2454 (2021)].

As a next step, we have recently extended our method to include substrates the height profile of which varies temporally in a prescribed manner. We compare two cases: First, we investigate a droplet on substrates with travelling wave wettability pattern by varying the speed and wave length of the pattern. Second, we investigate a droplet on substrates with a travelling wave height profile. In both scenarios, for small wave velocities the droplet moves steadily forward. In contrast, above a wave velocity the droplet performs steady oscillations. These speed oscillations correlate with oscillations in the shape of the droplet which decay linearly as a function of pattern speed.

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