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Two dimensional droplet spreading over chemically heterogeneous substrates RAJAGOPAL VELLINGIRI, NIKOS SAVVA, SERAFIM KALLIADASIS, Department of Chemical Engineering, Imperial College London, London SW7 2AZ, UK — We investigate the spreading dynamics of a partially wetting two-dimensional droplet over chemically heterogeneous substrates. The contact line singularity is removed by assuming slip at the liquid-solid interface. Assuming small contact angles and strong surface tension effects, a long-wave expansion of the Stokes equations yields a single evolution equation for the droplet thickness. The chemical nature of the substrate is incorporated through local variations in the microscopic contact angle, which appear as boundary conditions in the governing equation. By asymptotically matching the flow in the bulk of the droplet with the flow in the vicinity of the contact lines, we obtain a set of coupled ordinary differential equations for the locations of the two droplet fronts. We verify the validity of our matching procedure by comparing the solutions of the ordinary differential equations with solutions of the full governing equation. A number of interesting features that are not present in chemically homogeneous substrates are found, such as the existence of multiple equilibria, the pinning of the droplet fronts at localized chemical features and the possibility for the droplet fronts to exhibit a stick-slip-like behavior.

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