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Two-dimensional droplet spreading over random topographical substrates NIKOS SAVVA, Department of Chemical Engineering, Imperial College London, UK, GREG PAVLIOTIS, Department of Mathematics, Imperial College London, UK, SERAFIM KALLIADASIS, Department of Chemical Engineering, Imperial College London, UK — We examine theoretically the effects of a random topographical substrate on the motion of a two-dimensional droplet by developing appropriate statistical approaches. Our theory is based on a set of integro-differential equations for the two droplet fronts, previously obtained for deterministic substrates through a singular perturbation method. We provide a stochastic representation of random substrates as families of certain stationary random functions parametrized by a characteristic amplitude and a characteristic wavenumber. The droplet footprint is found to be a normally distributed random variable as it evolves towards equilibrium. The statistical analysis of the droplet shift along the substrate is highly non-trivial, but its variance can be deduced theoretically at early times and in the long-time limit. It is shown that substrate roughness tends to decrease the wetting properties of the droplet and that its approach to equilibrium is significantly slower for the droplet shift than its footprint, suggesting that the droplet has the tendency to slide without spreading along the substrate features in search for equilibrium. Our theoretical predictions are verified by numerical experiments.

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