Abstract Submitted
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Droplet motion on soft gels: comparing stiffness, strain, and surface energy gradient[1] SHIH-YUAN CHEN, Department of Physics, NC State University, AARON BARDALL, MICHAEL SHEARER, Department of Mathematics, NC State University, KAREN DANIELS, Department of Physics, NC State University — Motion of a droplet can be induced by depositing the droplet on a substrate with a gradient in substrate surface energy, surface stress, or stiffness. The motion is determined by the substrates surface stress, stiffness and strain state. The surface stress of a solid can be tuned via the surface energy or the surface strain of the solid, via the Shuttleworth effect. In this work, we describe our efforts to disentangle droplet motion induced by surface energy, surface strain, and stiffness. Using a 2-D model for a droplet on a soft substrate, we introduce a gradient in either solid surface energy or stiffness. The difference between the left and right contact angle sets a condition for gradient-induced droplet motion. We find that the droplet moves towards the lower solid surface energy or the lower stiffness. While the predicted threshold stiffness is too low to be relevant present for typically-used gel substrates, the threshold surface energy gradients fall within experimental ranges. Encouraged by our model, we cast a two-layer substrate: the bottom layer is UV-cured PAAM with a horizontal stiffness gradient, with a PVS layer on top. We then perform experiments by stretching the PAAM layer, inducing a strain gradient in the PVS which serves as an analog to the surface energy.

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