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Theory of the dynamics of evaporation-driven colloidal patterning[1] C. NADIR KAPLAN, Harvard University, NING WU, Colorado School of Mines, SHREYAS MANDRE, Brown University, JOANNA AIZENBERG, L. MAHADEVAN, Harvard University — In the suspensions of colloidal particles in a volatile liquid film, deposits of the solute form near the contact line due to the flow generated by evaporation. An enticingly simple and experimentally realizable model system of this mechanism is the drying of a spilled drop of coffee on the countertop. Similarly, patterns of periodic bands or continuous solid films are commonly observed on a substrate suspended vertically in a container of the colloidal solution. In order to characterize these patterns, we develop a multiphase model that couples both the liquid and solid flows, local variation of the particle concentration, the propagation dynamics of the solid front, and the liquid-air interface deformation. For vertical liquid films, we further determine the nature of the filming-banding transition and the phase boundary in terms of the volume fraction of the colloids. The results of our theory are in good agreement with direct observations of these patterns.

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