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Topography of Particle-laden Droplet Deposits on Soft Materials

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— A "coffee ring" is a particle deposit that can form when a particle-laden droplet evaporates, leaving particles near the droplet contact line. Observed in everyday life, such deposits appear in a wide range of liquid, particle, and substrate combinations. Previous studies focused on the fluidics of evaporating suspension droplets on rigid materials, where the ring formation was shown to occur for pinned contact lines and its possible suppression with surfactants, or other externally driven means were investigated. Here we investigate the effect of soft substrates and showed that we can control the topography of the deposit on demand by simply changing the environmental humidity, regulating the evaporative flux. We perform particle tracking of particle-laden droplets that dry on soft substrates at varied environmental conditions. We show with experimental observations and theoretical analysis that when droplets dry quickly, particles advect towards the receding contact line, which we relate to the viscous dissipation within the soft solid, retarding the contact line motion. Coffee ring formation in the presence of a receding contact line and its regulation by humidity bring a new perspective to the conditions of the manifestation of this frequent deposit topography.

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