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Marangoni-driven film climbing on a draining pre-wetted film NAN XUE, Princeton University, MIN PACK, Baylor University, HOWARD STONE, Princeton University — In this experimental study, we report a Marangoni flow generated when a bath of surfactant contacts a pre-wetted film, which is set by gravitational drainage on a vertical substrate. High-speed interferometry is used to measure the front position of the climbing film and the film thickness profile, and the effect of the surfactant concentration and the pre-wetted film thickness on the film climbing is studied. As a result, higher surfactant concentration induces a faster and thicker climbing film. Also, for high surfactant concentrations, where Marangoni driving dominates, increasing the film thickness increases the rise speed of the climbing front since viscous resistance is less important. In contrast, for low surfactant concentrations, where Marangoni driving balances with gravitational drainage, increasing the film thickness decreases the rise speed of the climbing front while enhancing gravitational drainage. We rationalize these observations by establishing a model that analyzes the climbing front, either in the Marangoni driving dominated region or in the Marangoni balanced, drainage region. Our work highlights the possible effects of the gravitational drainage on the Marangoni flow, both by setting a pre-wetted film and by resisting the film climbing.

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