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Stability of binary evaporating thin films XINGYI SHI, ERIC SHAQFEH, MARIANA RODRIGUEZ-HAKIM, GERALD FULLER, Stanford University — The dynamics and stability of thin liquid films over curved substrates affect us on a daily basis, from tear films to lubricant foaming. Even compositionally simple systems can exhibit complex behavior under the appropriate circumstances. In our work, we compare and contrast the behavior of an evaporating, binary silicone oil film over a glass dome and over an air bubble. We demonstrate that the interplay between Marangoni flows (related to liquid composition), evaporation, gravity, diffusion and capillarity dictates the behavior of these films. Our interferometric experiments show that when the Marangoni driving force is large enough, the initially axisymmetric film will eventually break symmetry. In computational solutions of the appropriate 2D lubrication model, we observe the same type of symmetry breaking bifurcation above a critical condition, defined by the liquid composition and diffusivity (i.e. Peclet number). A linearized disturbance analysis further reveals that the system is linearly unstable above a given Peclet number, but nonlinear effects can either be stabilizing or destabilizing in time.

Xingyi Shi
Stanford University

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