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Wrinkling of Thin Films Induced by Viscous Stress SOURAV CHATTERJEE, CHRISTINA MCDONALD, JIANI NIU, University of Pittsburgh, RUI HUANG, University of Texas, Austin, SACHIN VELANKAR, University of Pittsburgh — Compression of thin films attached to compliant solid substrates can induce a variety of highly ordered and complex wrinkling patterns. We study an analogous problem of the wrinkling instability of a thin film floating on a viscous fluid. Uniaxial compression of the fluid induces a viscous stress which leads to the wrinkling of the film. We experimentally determine the effect of geometry and material properties on the wrinkle wavelength. A shear lag approach is used to determine the stress distribution prior to buckling. A linear stability analysis of the film under this stress distribution is used to determine the maximally growing wavelength in the system. Both experiments as well as stability analysis show that the wavelength depends significantly on film length and the ratio of the film and fluid layer thickness. Most importantly, unlike previous research on fluid-supported films, the wrinkle wavelength is rate-dependent, and reduces with increasing compression rate.

Sourav Chatterjee
University of Pittsburgh

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