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The chocolate-egg problem: Fabrication of thin elastic shells through coating ANNA LEE, JOEL MARTHELOT, PIERRE-THOMAS BRUN, PEDRO M. REIS, Massachusetts Institute of Technology — We study the fabrication of thin polymeric shells based on the coating of a curved surface by a viscous fluid. Upon polymerization of the resulting thin film, a slender solid structure is delivered after demolding. This technique is extensively used, empirically, in manufacturing, where it is known as rotational molding, as well as in the food industry, e.g. for chocolate-eggs. This problem is analogous to the Landau-Levich-Derjaguin coating of plates and fibers and Bretherton's problem of film deposition in cylindrical channels, albeit now on a double-curved geometry. Here, the balance between gravity, viscosity, surface tension and polymerization rate can yield a constant thickness film. We seek to identify the physical ingredients that govern the final film thickness and its profile. In our experiments using organosilicon, we systematically vary the properties of the fluid, as well as the curvature of the substrate onto which the film is coated, and characterize the final thickness profile of the shells. A reduced model is developed to rationalize the process.

Anna Lee
Massachusetts Institute of Technology

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