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Marangoni effects on a thin liquid film coating a sphere with axial or radial thermal gradients DI KANG, ALI NADIM, MARINA CHUGUNOVA, Claremont Graduate University — We study the time evolution of a thin liquid film coating the outer surface of a sphere in the presence of gravity, surface tension and thermal gradients. We derive the fourth-order nonlinear partial differential equation that models the thin film dynamics, including Marangoni terms arising from the dependence of surface tension on temperature. We consider two different heating regimes with axial or radial thermal gradients. We analyze the stability of a uniform coating under small perturbations and carry out numerical simulations in COMSOL for a range of parameter values. In the case of an axial temperature gradient, we find steady states with either uniform film thickness, or with drops forming at the top or bottom of the sphere, depending on the total volume of liquid in the film, dictating whether gravity or Marangoni effects dominate. In the case of a radial temperature gradient, a stability analysis reveals the most unstable non-axisymmetric modes on an initially uniform coating film.

Ali Nadim
Claremont Graduate University

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