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Intrinsic instability of thin liquid films on nanostructured surfaces ARIF ROKONI, HAN HU, Drexel University, LIYONG SUN, The Behrend College, YING SUN, Drexel University — The instability of a thin liquid film on nanostructures is not well understood but is important in liquid-vapor two-phase heat transfer (e.g., thin film evaporation and boiling), lubrication, and nanomanufacturing. In thin film evaporation, the comparison between the non-evaporating film thickness and the critical film breakup thickness determines the stability of the film: the film becomes unstable when the critical film breakup thickness is larger than the non-evaporating film thickness. In this study, a closed-form model is developed to predict the critical breakup thickness of a thin liquid film on 2D periodic nanostructures based on minimization of system free energy in the limit of a liquid monolayer. Molecular dynamics simulations are performed for water thin films on square nanostructures of varying depth and wettability and the simulations agree with the model predictions. The results show that the critical film breakup thickness increases with the nanostructure depth and the surface wettability. The model developed here enables the prediction of the minimum film thickness for stable thin film evaporation on a given nanostructure.

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