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Modeling capillary-assisted thin film evaporation on hierarchical surfaces. ARIF ROKONI, TEJASWI SOORI, LIGE ZHANG, DONG-OOK KIM, YING SUN, Drexel Univ, DREXEL UNIVERSITY TEAM — Capillary-assisted liquid delivery significantly enhances evaporation rate during thin film evaporation on structured surfaces. At equilibrium, evaporation rate is balanced by liquid delivery, whereas contact line starts to recede when evaporation rate becomes dominant. Hierarchical surfaces may not always improve evaporation rate over microstructures. In the present study, a mathematical model is developed to predict evaporation rate on hierarchical surfaces by considering evaporation rate, liquid delivery, and micropillar level meniscus shape. The model shows improvement in evaporation rate on sparsely spaced micropillars decorated with nanorods compared to bare micropillars. The instantaneous shape of the receding meniscus was captured using laser interferometry and then used as an input in the model. Experiments show that the bulk receding front follows a two-stage motion, slower around the micropillars but faster in-between pillars and the evaporation rates measured using thermocouples agree well with model predictions. The model sheds light on more effective designs of hierarchical surfaces for enhanced thin film evaporation.

Arif Rokoni
Drexel Univ

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