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Dry spot growth dynamics during thin film evaporation on hierarchical surfaces. ARIF ROKONI, DONG-OOK KIM, LIGE ZHANG, FAUSTO PASMAY, YING SUN, Drexel University — The topography of structured surfaces plays a significant role in increasing the critical heat flux (CHF) during thin film evaporation by enhancing capillary-assisted liquid delivery to the evaporating thin film region. As the CHF is reached, evaporation becomes dominant, leading to the formation of dry spots. In this study, the contact line dynamics during dry spot growth is investigated for thin film evaporation on hierarchical micro/nanostructured surfaces with ZnO nanorods grown on silicon micropillars of varying spacings and heights. Using laser reflection interference microscopy, the 3D meniscus shape at the micropillar level and the contact line dynamics at two length scales are directly captured. Nanoscale receding front is found ahead of bulk receding during dry spot growth on hierarchical surfaces, where the bulk receding front follows a two-stage motion, slower around the micropillars and faster in-between pillars. This nanoscale precursor film, due to the presence of nanorods, contributes significantly to the evaporative heat flux. The detailed understanding of dry spot growth dynamics sheds light on more effective designs of hierarchical surfaces for CHF enhancement.

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