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Effects of contact lines on evaporative heat transfer of liquid films JUNGTAEK KIM, HANSEUL CHOI, YUN SEOG LEE, HO-YOUNG KIM, Seoul National University — Falling film evaporators cool liquids that flow through a bundle of tubes, over which refrigerants are sprayed and evaporated. A key parameter to determine the heat transfer coefficient is the film Reynolds number (Re) that depends on the spraying amount of refrigerant. Because dry-out of tube walls occurs when Re is too low while the liquid film becomes too thick for too high Re, an optimal Re exists that maximizes the heat transfer coefficient. Here we show that the optimal Re for evaporative heat transfer over geometrically patterned tube walls is also critically affected by the enhanced mass transfer rate at the solid-liquid-gas three phase contact lines. It is experimentally found that the heat transfer of partially filled grooves with contact lines is more efficient than completed wet grooves, despite the decreased heat transfer area. We experimentally measure the heat transfer coefficient from various surface patterns under contact line effects. Then we provide a mathematical model to optimize enhanced surface features maximizing evaporative heat transfer coefficient.

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