Fundamental Experimental Investigation of Thin-film Evaporation

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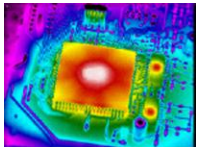
Objective

Develop comprehensive understanding of transport phenomena occurring near the contact line of evaporating thin liquid films

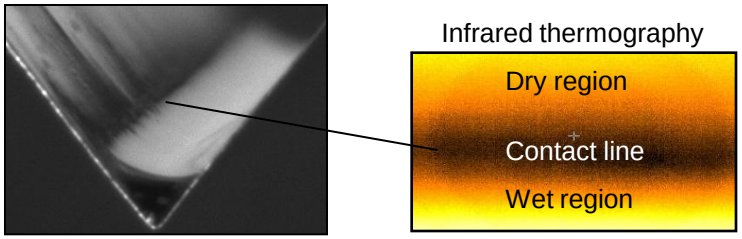


Hot-spots can be potentially cooled using thin-film evaporation

Approach

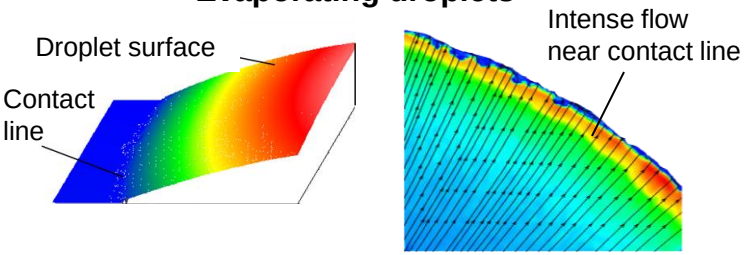
- Utilize various measurement techniques to experimentally characterize heat and mass transport of liquid films in important geometries
- Develop experimentally validated numerical models
- Design novel heat transfer devices which effectively exploit thin-film evaporation

Liquid meniscus in V-groove



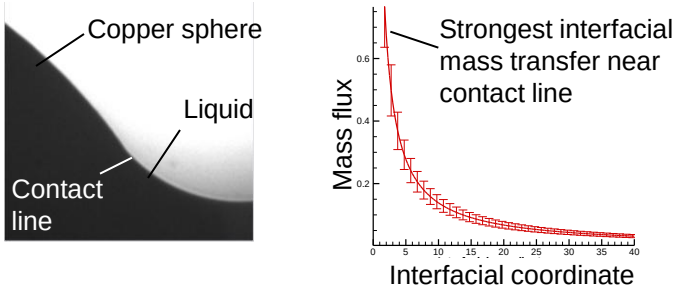
Dark band in IR image of groove wall indicates cooling effect of intense evaporation near contact line

Evaporating droplets



Interferometry and μPIV provide droplet profiles and internal flow vectors during evaporation

Evaporation from a bed of spheres



Evaporation from a bed of spheres simulates the pore level mass transfer from a heat pipe wick

Impact

- Thin-film evaporation shown to be dominant heat transport mechanism in many two-phase systems
- Sustaining and enlarging thin-film area could dramatically enhance heat dissipation capabilities of next-gen devices

Selected Publications

- Migliaccio and Garimella, Int. J. Heat Mass Transfer 54, 3440-3447, 2011.
- Migliaccio et al., Int. J. Heat Mass Transfer 54, 1520-1526, 2011.
- Dhavaleswarapu et al., Langmuir, 26, 880-888, 2010.

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