On the Transient Thermal Response of Thin Vapor Chamber Heat Spreaders: Governing Mechanisms and Performance Relative to Metal Spreaders

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Objective and Approach

- Identify the mechanisms governing vapor chamber transport under transient operation
- Compare the transient thermal performance of vapor chamber to solid metal spreaders

Model Validation

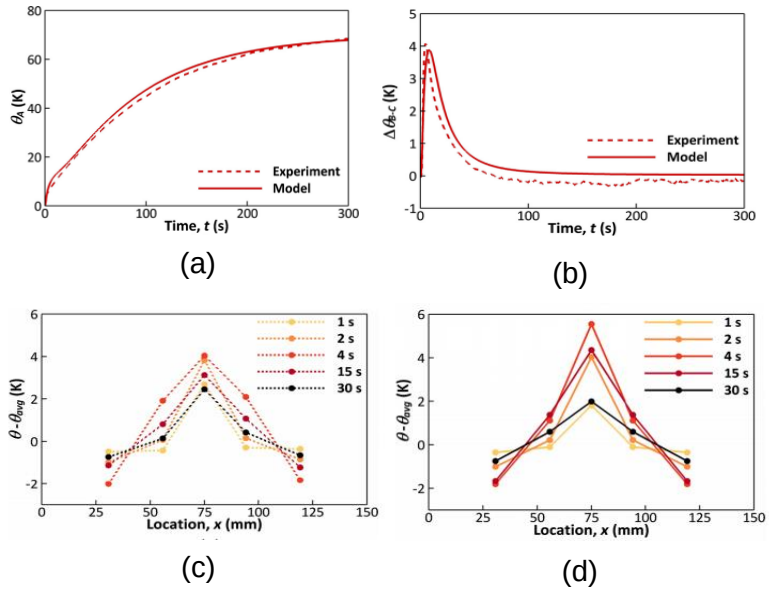

Figure showing temporal (a & b), and spatial (c & d) temperature profile comparison of the 3D time-stepping analytical model [1] with experiments for a thin flat heat pipe.

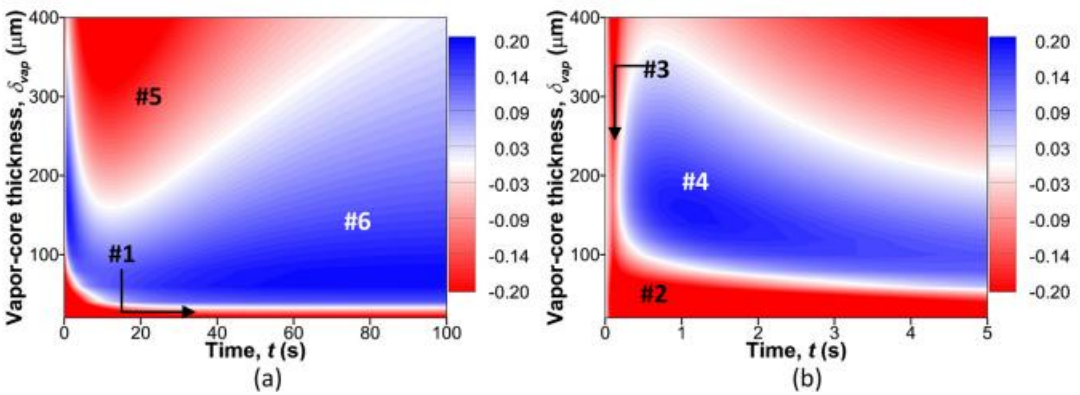

Figure showing relative transient performance of vapor chamber to a metal heat spreader in terms of maximum evaporator temperature

Impact

Three key mechanisms governing vapor chamber transient thermal response were identified [2]

1. Total thermal capacity governs the rate of increase of volume-averaged temperature
2. Effective in-plane diffusivity governs time required for the spatial profile to develop
3. Vapor core conductance governs the spatial temperature variation

Publications

[1] G. Patankar, J.A. Weibel, and S. V Garimella, "A validated time-stepping analytical model for 3D transient vapor chamber transport," *International Journal of Heat and Mass Transfer*, vol. 119, 2018, pp. 867–879

[2] G. Patankar, J.A. Weibel, and S. V Garimella, "On the transient thermal response of thin vapor chamber heat spreaders: Governing mechanisms and performance relative to metal spreaders," *International Journal of Heat and Mass Transfer*, vol. 136, 2019, pp. 995–1005

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