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Experimental investigation of a vapor chamber featuring wettability-patterned surfaces[1] THEODORE KOUKORAVAS, GEORGE DAMOULAKIS, CONSTANTINE MEGARIDIS, UIC — Wettability patterning has been shown to increase condensation performance and transport liquid microvolumes pumplessly at speeds O(0.1 m/s), even against gravity. Vapor-chamber heat spreaders are hollow heat sinks that house metal wicks inside to circulate a phase-changing liquid and spread heat more efficiently than solid-metal heat sinks. However, metal wicks, besides providing pumpless fluid transport, also come with capillary limitations due to high pressure drops. Wettability patterning does not pose the same limitations and has potential to replace metal wicks for transporting fluids faster and more efficiently, in addition to effectively regulating filmwise and dropwise condensation. Thus, an intriguing hypothesis is explored here by incorporating wettability patterning (i.e. eliminating wicks) inside vapor chambers. Multiple copper vapor chambers incorporating wettability patterns with different ratios of superhydrophilic to hydrophobic areas on the condenser side are experimentally investigated. The devices are tested at different configurations. The lowest thermal resistance achieved is 0.24 K/W at 87 W heat load. The current work demonstrates the promise of wettability patterning for inclusion in vapor chambers.

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