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Permeability Characterization of Capillary Flow through Vertically Aligned Pillars CONAN ZHANG, CARLOS HIDROVO, University of Texas-Austin — Darcy's law is a constitutive equation that relies on an empirical value, the permeability (κ), to correlate the flow rate with the pressure gradient within the porous structures. The permeability is primarily dependent on the microstructural details such as the tortuosity and porosity, which are statistical in nature. With the advent of micromanufacturing techniques, it is now possible to create porous structures with regular and well defined features. This opens the possibility of creating structures that have been optimized for capillary performance. In this research, an analytical model was developed to simulate capillary flow through an array of vertically aligned pillars. The analysis is based on a quasi-steady state balance between viscous and capillary forces on a substrate consisting of alternating micropillar and flat surface regions. The model is used to predict the capillary limit of micropillar arrays under thermal loads for heat pipe applications and validated against experimental data of silicon samples in an open loop setup. It is shown that the optimal pillar spacing is directly related to its aspect ratio.

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