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Vapor bubble evolution on a heated surface containing open microchannels[1] CHRISTOPHER J. FORSTER, ARI GLEZER, MARC K. SMITH, Georgia Institute of Technology — Power electronics require cooling technologies capable of high heat fluxes at or below the operating temperatures of these devices. Boiling heat transfer is an effective choice for such cooling, but it is limited by the critical heat flux (CHF), which is typically near 125 W/cm^2 for pool boiling of water on a flat plate at standard pressure and gravity. One method of increasing CHF is to incorporate an array of microchannels into the heated surface. Microchannels have been experimentally shown to improve CHF, and the goal of this study is to determine the primary mechanisms associated with the microchannels that allow for the increased CHF. While the use of various microstructures is not new, the emphasis of previous work has been on heat transfer aspects, as opposed to the fluid dynamics inside and in the vicinity of the microchannels. This work considers the non-isothermal fluid motion during bubble growth and departure by varying channel geometry, spacing, and heat flux input using a level-set method including vaporization and condensation. These results and the study of the underlying mechanisms will aid in the design optimization of microchannel-based cooling devices.

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