Abstract Submitted
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Single Bubble Dynamics on Superhydrophilic Micropillar Arrays during Flow Boiling[1] JIANSHENG FENG, SIYU CHEN, Massachusetts Institute of Technology, TIEJUN ZHANG, Masdar Institute of Science and Technology, EVELYN WANG[2], Massachusetts Institute of Technology, DEVICE RESEARCH LABORATORY TEAM — Micro/nanoengineered surfaces have received recent interest for high heat flux thermal management solutions. In particular, micropillar arrays promise opportunities to enhance flow boiling performance, but an increasing understanding of the role of these structures are still needed. In this study, we used superhydrophilic micropillar arrays with well-defined geometries to investigate bubble growth and departure dynamics during boiling. These structures were individually tested in a closed-loop flow boiling setup. A combined side-view microscopy and high-speed videography technique was utilized to obtain images of bubble growth and departure. We demonstrated that by increasing the solid fraction of the microstructures, bubble departure can occur at smaller sizes and at higher frequencies comparing to that on a flat hydrophilic surface. Meanwhile, we observed that bubble sliding stage between departing from the nucleation site and detaching from the heated surface, which is present under a wide range of conditions during flow boiling on flat surfaces, was highly suppressed on some of the microstructured surfaces. In addition, we used a surface energy based model to explain the confinement effect of the liquid-vapor interface by the micropillar arrays, and to support our experimental findings that solid fraction is a key parameter dictating bubble dynamics.

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