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3:20 PM, Monday, November 22, 2021

Abstract: N01.00122 : Experimental Study of Pool Boiling Heat Transfer on Novel Pin-Finned Surfaces *

← Abstract →

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The rapid advancement of microelectronics has posed considerable challenges to the thermal management of extreme heat loads, exceeding 1000 W/cm^2 , discharged from confined areas in many electrical systems. Boiling heat transfer associated with phase change is perhaps one of the most efficient cooling methodologies due to its large latent heat. Pin fin structures are commonly used to increase boiling heat transfer from the heated surface and have shown better performance than conventional fin-type heat sinks. This work aims to experimentally investigate the heat transfer performance of two pin-finned structures, namely solid and hollow pin fins, in a pool boiling facility. The hollow pin fin structure is designed to enhance the fin's heat transfer performance by adding an additional artificial nucleation site. With pin fin heat sinks including a flat plane surface, different bubble growth parameters, such as bubble departure diameter, bubble growth time, bubble departure frequency, and a bubble waiting time, are thoroughly visualized and examined using high-speed imaging. Pool boiling experiments to estimate heat transfer rates and heat transfer coefficients are performed in atmospheric pressure conditions using deionized water. The obtained experimental data are compared with models and data available in the literature to assess the validity of the results. The preliminary results show that, as expected, the pin-fin heat sinks show a much better heat transfer rate when compared to that on a plane surface. Also, the hollow pin-fin structure shows better heat transfer performance when compared to the other two surfaces. This is attributed to the fact that the hollow fin has more active nucleation sites, a better rewetting phenomenon, and a favorable bubble growth and release mechanism. The overall heat transfer rate and interpretation of heat transfer enhancement on the hollow pin fin structure are studied.

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