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Understanding the Flow Mechanism in Micro Pulsating Heat Pipes Using Image Recognition CHIHIRO KAMIJIMA, YUTA YOSHIMOTO, SHU TAKAGI, IKUYA KINEFUCHI, Department of Mechanical Engineering, The University of Tokyo — Heat generation in electronic devices has recently become a significant issue owing to their miniaturization and integration. Pulsating heat pipes (PHPs), which facilitate heat transfer via self-oscillation of liquid slugs, are promising devices thanks to their simple wickless structure and ease of miniaturization. However, complex and chaotic flow mechanism of PHPs has yet to be understood sufficiently, necessitating further investigation for device optimization. In this study, we fabricate a micro-PHP with a hydraulic diameter of 350 μm, and measure the PHP thermal conductivities using FC-72 as a working fluid under various conditions. We also visualize inner flows with a high speed camera and extract flow patterns using an image recognition technique. The results show that long and thin liquid films generated on the channel walls are of importance for effective heat transfer. Additionally, we model inner flows and heat transfer of the micro-PHP, and conduct numerical analyses using the extracted flow patterns. We find that latent heat transfer via the liquid films accounts for a significant portion of the overall heat transfer, while sensible heat transfer by the liquid slugs is negligible small.

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