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蛇行ミニチャネルおよび金属焼結多孔質体を有するヒートパイプの熱輸送特性

Heat transport characteristics of the heat pipe with a meandering mini-channel and sintered metal porous

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In recent years, Pulsating Heat Pipes (PHP) [1)] have been attracting attention for high-performance cooling of electronic devices. Improving the performance and operational stability of PHP has become an important challenge. Regarding the enhancement of the performance of PHP, Qu et al. [2)] conducted experiments using the PHP with the channel sintered a thin metal porous layer on the bottom surface and reported that the thermal resistance was reduced by promoting nucleate boiling. In this study, a novel heat pipe with meandering mini channels whose walls were composed of the sintered metal porous was fabricated to increase the heat transfer performance and operational stability regardless of the orientation of the PHP by the effect of capillary wicking. The transfer and visualization experiments were carried out by using the PHPs with/without porous and the characteristics of heat transport and flow behavior were investigated.

Figure 1 shows the heat pipe with sintered metal porous (Porous HP) used in this study. The copper fine particles layer with a thickness of 0.8 mm were sintered on the 130 ×100 mm copper plate. The meandering groove for flow channel were fabricated on the porous layer with a thickness of 0.8 mm, i.e., the bottom of the channel was the bared copper. The cross-sectional shape of the channel was rectangular and the hydraulic diameter was 0.89 mm. The number of turns was 10 for each side. To confirm the effect of the porous, we also prepared Bared-PHP by cutting the same groove as Porous HP on a copper plate. Heating and cooling to the heat pipe was performed via respective copper block installed at the back of the channel. Thermocouples were inserted near the turns in the heating and colling sections to measure temperatures. As shown in **Figure** 1, one side of the channel was sealed by crimping a visualization block, and a CCD camera was used to observe the flow behavior. The degassed distilled water was used for the working fluid.

Firstly, experiments are conducted on bottom-heated Bared-PHP by varying the volume fraction of the working fluid in the range of 10% to 95 %, however, no self-excited oscillation occurs. In previous study, it was also reported that the self-excited oscillation of water was less likely to occur[3)]. On the other hand, Porous HP is confirmed that the fluid is driven, and the thermal resistance is significantly reduced as the heat transfer rate increases. Although the flow pattern differs greatly depending on the orientation of the heat pipe, the

reduction rate of thermal resistance is almost the same. The nucleate boiling is observed under the vertical orientation, in contrast, no boiling occurs and the evaporation from the gas-liquid interface mainly advanced for the horizontal orientation.

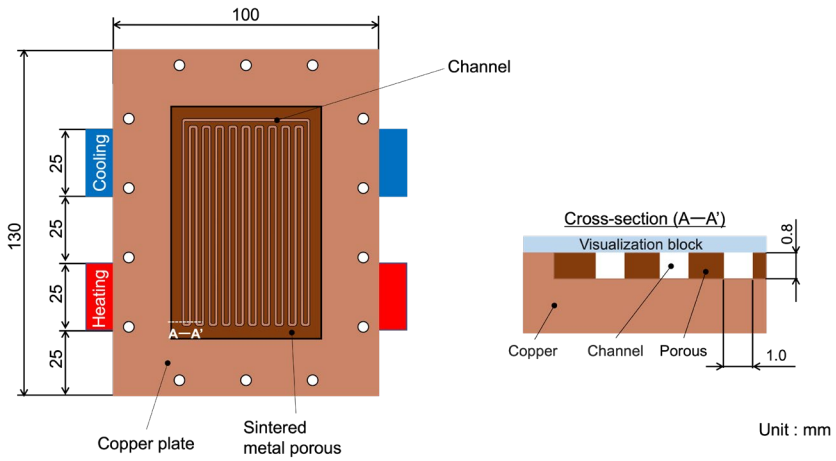

Figure 1. Schematic of Porous HP

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