PROPOSAL OF UTILIZING UNI-DIRECTIONAL POROUS COPPER FOR EXTREMELY HIGH HEAT FLUX REMOVAL

Kazuhisa Yuki, Tokyo University of Science-Yamaguchi
kyuki@rs.tus.ac.jp
Kio Takai, Tokyo University of Science-Yamaguchi
Yoshiki Indou, Tokyo University of Science-Yamaguchi
Koichi Suzuki, Tokyo University of Science-Yamaguchi

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This paper proposes new heat removal devices utilizing uni-directional porous copper against extremely high heat flux conditions. Before designing those, we discuss some key parameters of porous media to enable a high heat flux removal over 10 MW/m^2 at a low flow rate of water, which are effective thermal conductivity, permeability, liquid supply to a heat transfer surface, and contact thermal resistance between the porous medium and the heat transfer surface. These discussions indicate utilizing the uni-directional porous media as shown in Fig. 1 from the view point of its higher thermal conductivity, direct supply of cooling liquid toward the heat transfer surface, discharge of vapor, reduction in flow resistance and the thermal contact resistance.

The experimental apparatus is composed of the coolant supplying pump, the heat transfer test section, and the heat exchanger. Distilled water is used as cooling liquid. The heat transfer test section mainly consists of the heat transfer block and the uni-directional porous medium attached at the heat transfer surface. High power of eight cartridge heaters are utilized as the heat source and the heat transfer copper block is designed in order to achieve the heat flux of over 10 MW/m^2 at the heat transfer surface of 20 mm in diameter. The uni-directional porous copper has the small holes of 0.5 mm in diameter for the liquid supply and the big holes of 2.8 mm in diameter for the vapor discharge, as shown in Fig. 1 on the right. The thickness is 10 mm and the diameter of the porous medium is 20 mm. As a result, the heat transfer experiments prove that utilizing the uni-directional porous cooling device strongly enhances the evaporation rate of the cooling liquid and drastically improves the heat transfer performance as well as being able to reduce the pressure loss.

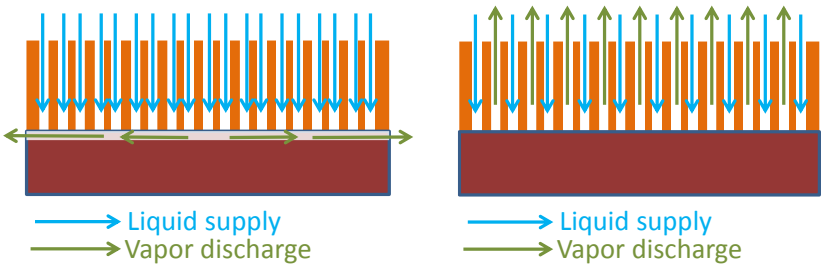

Fig. 1 Utilization of uni-directional porous media for high heat flux removal