# §15. Development of Hybrid-porous Evaporator for FFHR Divertor Cooling

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High temperature salt Flibe has been proposed as one of coolant/breeder materials for FFHR. For constructing an ideal energy transfer system, it is desirable that the divertor that is the highest heat loading equipment should be also cooled down by using Flibe. However, taking into account the Flibe operation temperature, the structural material and the level of the heat flux, it is in a difficult situation to construct the divertor heat removal system using Flibe. Whereas the development of the power reactor must be considered in an earlier stage, the other divertor-cooling system should be proposed to solve the engineering issues at first. In this study, high power density heat transporting device using mechanically demountable metal porous material is proposed from the view points of the soundness and profitability of FFHR. Concretely, a hybrid cooling device which functionally possesses bi-pore structures for the liquid supply and for the vapor discharge is newly proposed to evaluate the heat transfer performance.

The heat source is plasma arcjet of the Tohoku University, and here it's possible to perform the heat transfer experiments over the heat flux of 10MW/m$^2$. Fig. 1 is the test section and composed of a circular pipe inserted the porous medium and a copper heat transfer block irradiated by the plasma. The copper heat transfer block is cooled by passing cooling water through the porous medium attached to the backside of the copper block. The porous media are the particle-sintered ones with foam-like structure, and have the large pore and small pore structures as shown in Fig. 2. The high temperature vapor formed in the porous medium is discharged through the large pore with high permeability to the outside, and in addition, the liquid is positively supplied to the vapor region by the capillarity and pumping effects.

In this fiscal year, reference data against the heat transfer characteristics of the above mentioned porous media are obtained for comparison. The porous media used are the copper foams with the pore diameter of 500, 840, 1240 μm as single pore structure. Fig. 3 shows the heat transfer performances. Though the heat flux input is about 5MW/m$^2$, the heat transfer coefficients decreases with decreasing flow velocity at this heat flux level. Since the wall temperature exceeds 200 deg. C, there definitely exists an excessively developed vapor region as an insulating layer. That is to say, it is the most important point to develop the bi-porous structure to let efficiently discharge this vapor to the outside of the porous medium.

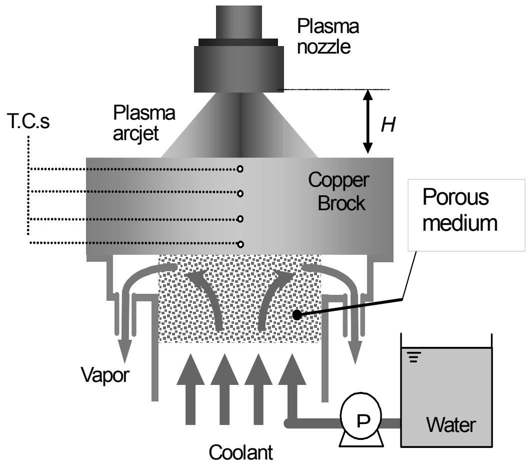


**Fig.1** Test section

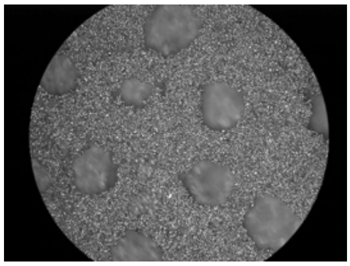

**Fig.2** Bi-porous structure

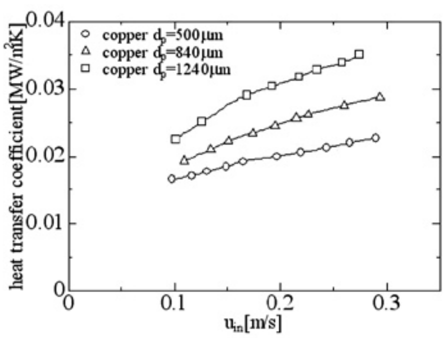


**Fig. 3** Heat transfer performance of Single-structured porous media

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[1] A., Sagara, S. Imagawa, et al., Fusion Engineering and Design, vol. 81, 2006, pp.1299–1304.
[2] K. Yuki, et al., Journal of porous media, vol. 14, (2011).