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LHDにおける非蒸発型ゲッターポンプを用いたダイバータ粒子排気特性

Divertor pumping using in-vessel Non Evaporable Getter (NEG) pumps in the LHD

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The application of Non Evaporable Getter (NEG) pumps to fusion devices is discussed. The NEG pumps have an advantage of the operation temperature at 100-200ºC, in which there is a high tolerance of the temperature increase due to a plasma radiation and/or unexpected heat load from heating devices. The NEG pumps are installed as an in-vessel divertor pump into the divertor region in the Large Helical Device (LHD) for the first time. The pumping performance test shows that the efficient pumping speed is 10 m^3/s in hydrogen, which is close to the target value. The establishment of the operation scenario, which is consistent with other pumping facilities and with wall conditionings such as hydrogen (deuterium) glow discharges, is still an issue to be discussed. However, the application of NEG pumps to current fusion devices is a milestone for the possibility of use of NEG pumps in future fusion devices.

A vacuum pump is an essential tool in order to exhaust and control neutral particles in fusion plasmas. So far, in the vacuum pumps, cryogenic pumps such as cryo-sorption and cryo-condensation, turbo molecular pumps and mechanical pumps are utilized in many fusion devices. In this study, NEG pumps are introduced to the divertor pumps as a new pumping facility. The target pumping speed for the NEG pumps is set up at 10 m^3/s in hydrogen. The HV400 wafer module produced by SAES Getters S.p.A. was applied. The design using CAD drawing shows totally 42 modules can be possible to be installed in one toroidal divertor section.

The pumping performance was tested as shown Figure 1. NEG pumps gave the pumping speed of about 10 m^3/s after the 2nd activation in which higher temperature was set up comparing with in 1st activation. The obtained pumping speed is close to the target value. In order to be an in-active state of NEG pumps, the saturation of the surface by nitrogen gas is conducted. For 10 hours passivation, the reduction is around 8%, and for 100 hours passivation it is around 1-2%. The discussion of the operation scenario of the NEG pumps indicates that the time of 22 hours is required to change the state from the active to in-active state. Although almost one day is consumed for the active/in-active process of the NEG pumps. The establishment of the operation scenario consistent with other pumping facilities and with wall conditionings is an issue to be solved.

In this study, the heat load calculation from the NEG pumps to the first wall will be presented using ANSYS. Moreover, the conductance of the HV400 module will be evaluated using a fully three-dimensional neutral particle transport simulation code EIRENE.

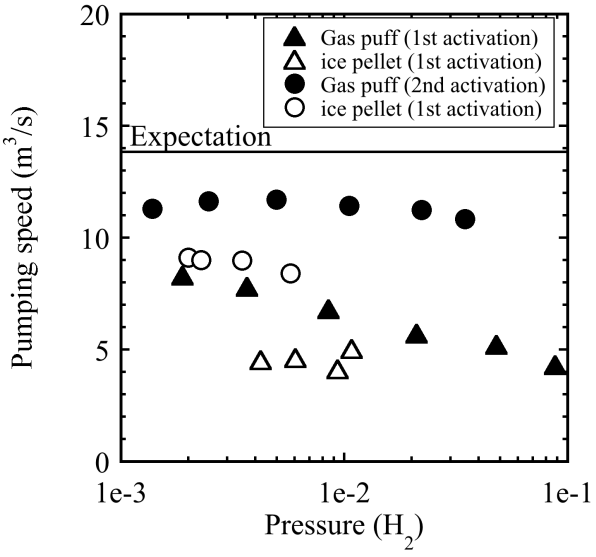

Fig. 1 The result of the pumping speed is shown. Solid symbols are the result by gas feed and open symbols are the result by pellet injection. Black squares represent the pumping speed after the 1st activation and red circles represent the pumping speed after the 2nd activation.