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QUESTにおける第一壁材料水素透過実験
Hydrogen permeation probe experiments in QUEST

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In magnetic fusion power devices, hydrogen particles will escape from the confinement region and then migrate through the first wall by plasma-driven permeation (PDP) into the blanket region [1]. Edge particle flow measurements in the QUEST tokamak have been conducted, using a permeation probe [2] that employs a first wall candidate ferritic steel alloy: F82H as a membrane and also SUS304 as a comparative reference. The membrane thickness varies from 0.14 to 0.5 mm and the temperature is between 200°C and 300°C. Permeation measurements have been done both during conditioning steady-state discharges, and confinement plasma discharges heated with 2.45 GHz and 8.2 GHz ECR. Diffusion and recombination coefficients measured in a laboratory-scale plasma device: VEHICLE-1 [3] are used to interpret the results from the measurements in QUEST. To investigate the effects of surface impurities, the permeation membranes after PDP experiments are analyzed by depth profiling X-ray photoelectron spectroscopy.

Figure 1 shows a comparison of PDP data taken from SUS304 and F82H, both in QUEST for 15-min long pulse shots with simultaneous 2.45 GHz and 8.2 GHz ECR heating. The permeation flux keeps increasing until the end of the discharge for the SUS304 membrane. For F82H, however, the steady-state PDP flux can be reached within ~200 s after plasma start-up. The steady-state permeation flux through the F82H membrane has been found to decrease by ~13% without the 25 kW-8.2 GHz ECR input. In the XPS analysis, C, O, Cr, Fe, W and Ni have been detected, among which C has been found to be the dominant impurity on the membrane surface.

References

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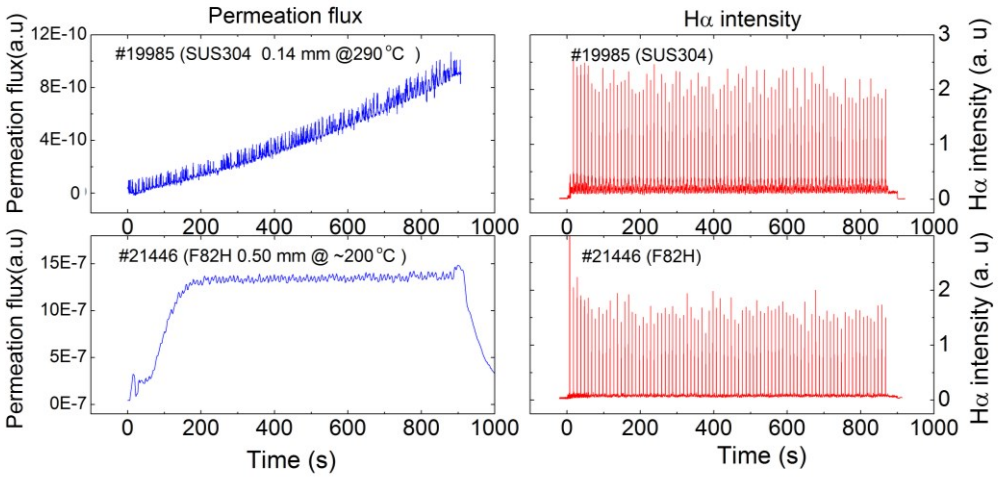

Fig.1 Comparison of PDP between SUS304 and F82H in QUEST.