§65. Suppression of Hydrogen Recycling by Liquid Lithium Wall

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Lithium coating has been regarded as a powerful tool of fusion wall conditioning due to its strong gettering ability of oxygen impurities, and due to its lower hydrogen recycling characteristics. So far, we have studied interaction of lithium wall with hydrogen plasmas, and reported effect of lithium conditioning on the suppression of oxygen, carbon impurities and hydrogen recycling through laboratory experiments[1-6]. In future fusion devices, however, candidates for divertor wall material are very few because of high heat flux to the wall. Recently, much attention has been given to liquid lithium as a new candidate, because liquid can effectively remove heat flux according to its high heat conductivity. However, interaction of liquid lithium with hydrogen plasma is not well known. In this study, we examine interaction of liquid lithium with hydrogen plasma, using a laboratory-scale experimental apparatus.

Experiments are performed in a cylindrical vessel with 30 cm in diameter and 60 cm in length as shown in Fig. 1. The vessel is pumped to ~10^{-7} Torr by a turbo molecular pump. Sample lithium (3.5 g) is set on an oven plate (stainless steel, 14 cm in diameter), which can be heated up to 400 °C. Lithium is visually observed through a viewing port at the top of the vessel. Before examining the hydrogen absorption characteristics of liquid lithium, the lithium is heated above the melting temperature (~195 °C), and is spread in the oven plate. Then the lithium is exposed to a hydrogen plasma which is produced by a dc glow discharge between a mesh anode and the vessel as a cathode (discharge voltage ~300 V, discharge current 0.2 A, H_2 pressure ~30 mTorr). Temporal variation of H_2 pressure during the discharge is monitored by a differentially-pumped quadrupole mass spectrometer. The hydrogen uptake into the lithium is evaluated by the pressure decrease during the discharge as a function of lithium temperature. Wall pumping of hydrogen in the absence of lithium oven is confirmed to be negligible compared with that of lithium.

Figure 2 shows hydrogen absorption flux into lithium at oven temperatures from 30 °C to ~195 °C. At temperatures from 30 to 160 °C, hydrogen absorption into lithium slightly increases with the oven temperature. However, at lithium temperatures above 180 °C, *i.e.*, lithium melting point, hydrogen absorption becomes lower than that of solid lithium. To check reproducibility of hydrogen absorption characteristic, the lithium temperature was again lowered below the lithium melting point, and then the hydrogen absorption increased as before. The result indicates a to reduction of hydrogen uptake in case of liquid lithium. Decrease in hydrogen absorption at higher temperature is not well understood and is now under study.

References

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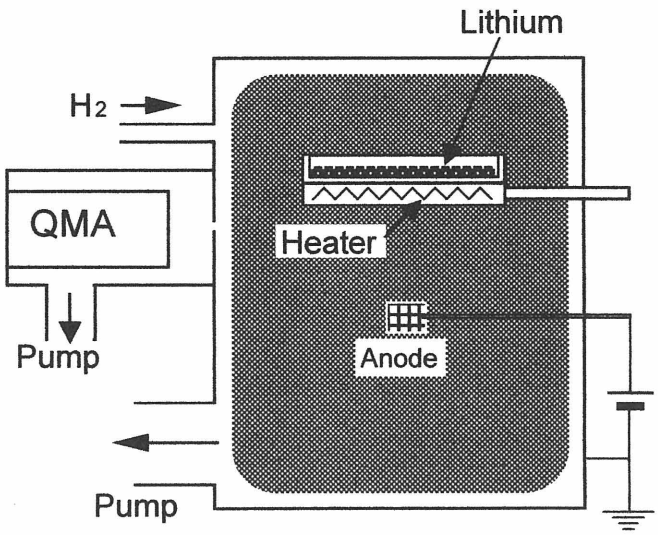

Fig. 1. Schematic of experimental apparatus.

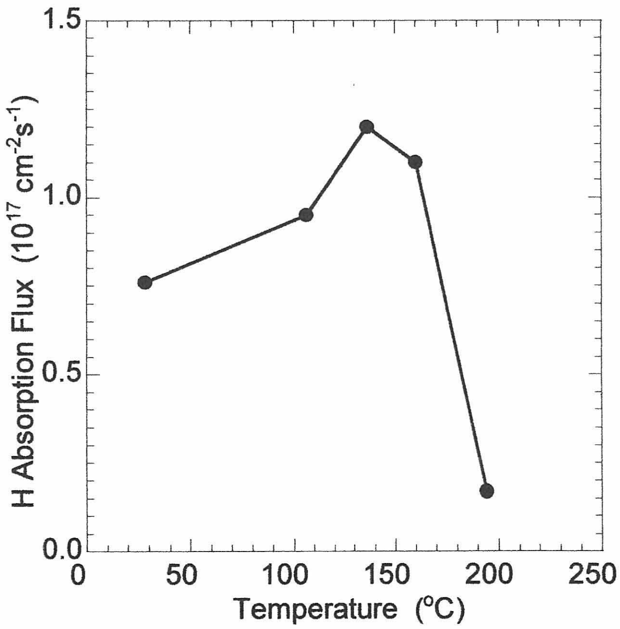

Fig. 2 Temperature dependence of H absorption by Li