§70. Suppression of Hydrogen Recycling by Liquid Lithium Wall

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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[1-5]. In future fusion devices, however, candidates for divertor wall material are very few because of high heat flux to the wall. 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 small 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. A sample wall (stainless steel, 14 cm in diameter) which can be heated up to 400 °C is inserted into the vessel through a load-lock systemand lithium is deposited on the sample by a lithium oven. After the lithium evaporation, the sample wall is exposed to a hydrogen plasma which is produced by a dc glow discharge between a mesh anode and the vessel as a cathode. 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.

Figure 2 shows temporal variation of hydrogen absorption flux into lithium-deposited wall at sample-wall temperatures of 30 °C and 330 °C. The wall temperature of 330 °C is above the melting point of lithium (179 °C). Film thickness deposited on the sample wall is 100 nm, which is monitored by a in-situ quartz crystal oscillator. At a sample wall temperature of 30 °C, a hydrogen absorption of ~6×10^{15} molecules/cm^{2}s is observed immediately after the discharge ignition, and the absorption gradually decreases with the time. At higher wall temperature of 330 °C, the hydrogen absorption of 2×10^{15} molecules/cm^{2}s is observed, although the absorption flux is three times lower than that at lower temperature (~30 °C). The result indicates the possibility of liquid lithium wall to reduce hydrogen recycling. Decrease in hydrogen absorption at higher temperature is not well understood and is under study.

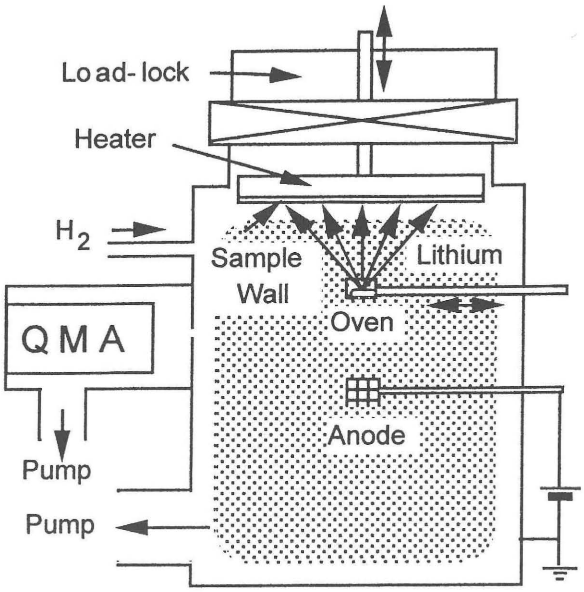

Fig. 1. Schematic of experimental apparatus.

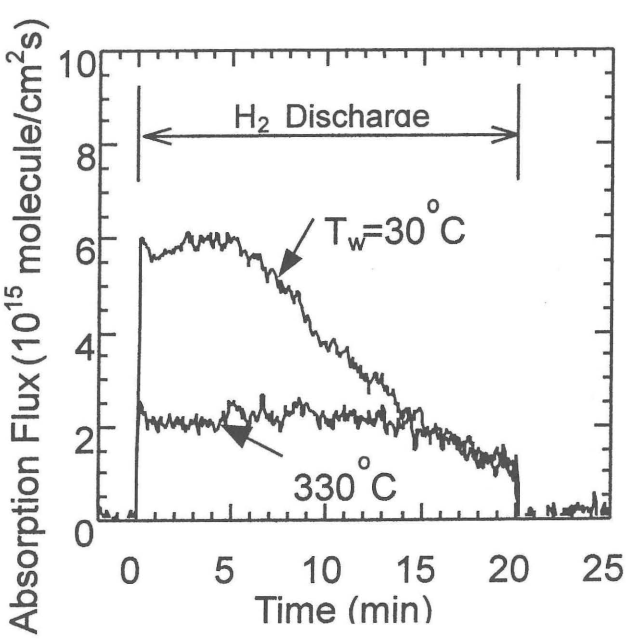

Fig. 2. Temporal dependence of hydrogen absorption flux to the lithium wall at temperatures of 30 °Cand 330 °C.

References
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