

§6. Dynamic and Static Properties of Wall Recycling in the Long Duration Discharges

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The achievement of the stable long pulse operation is one of the requirements for the future fusion reactor. The global particle balance in the main chamber and its control are critical in achieving the steady state operation. The control of the global particle balance depends on the wall recycling. The wall recycling changes with a long time constant depending on the wall condition. However, not only the wall condition but also plasma condition (e.g., particle flux out of the plasma) influences the wall recycling property. In such transient phenomena as edge localized modes or the pellet injection, the wall would considerably contribute for pumping the particle flux out of the plasma. In TRIAM-1M, it has been observed that there exists a quite large difference between properties of wall recycling in the static condition (i.e. the continuous gas feed case) and the dynamic condition (i.e. the additional gas puff case) [1]. In this time, similar experiments were carried out on LHD to promote better understanding of the wall recycling.

Figure 1 shows the time evolution of the line averaged electron density \bar{n}_e in the cases of additional gas puffs and gas feed termination in plasmas heated by NBI of which beam direction is CCW. The additional gas puffs were carried out five times at the interval of 5 s as shown by the arrows in the figure. The gas feed was stopped at $t \sim 5$ s, 15 s and 25 s in separate discharges. The decay time of \bar{n}_e after the gas puff (i.e. dynamic condition) and the termination of the gas feed (i.e. static condition) means the effective particle confinement time τ_p^* and it is a good scale for the evaluation of the wall recycling, since it is defined as $\tau_p^* / (1 - R)$, where τ_p is a particle confinement time and R is a recycling coefficient. Figure 2 shows the density decay time in the dynamic and static conditions as a function of the discharge duration. Clear difference can be seen between both conditions. The decay time in the static condition increases with the discharge duration and it seems to saturate after $t \sim 15$ s. That in the dynamic condition slightly increases with the discharge duration. The large difference of the density decay time between both conditions is similar to the result of TRIAM-1M.

On the other hand, when another NBI system of which beam direction is CW is used, no clear difference between both conditions can be seen as shown in Fig.3. In this case, the density decay time of the static condition is almost the same as that of CCW NBI plasma. However, that

of the dynamic condition is larger than that of the CCW NBI plasma. It may suggest that the behavior of the particle confinement time against the gas puff is different between CW and CCW NBI plasmas.

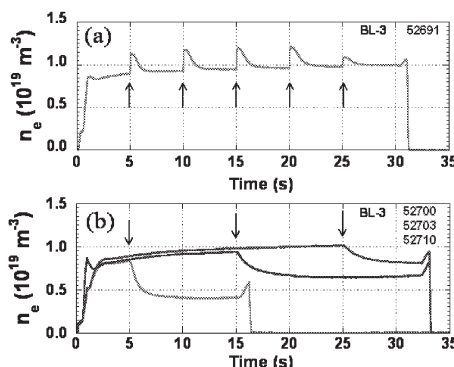


Fig.1 Time evolution of the line averaged electron density in the cases of the gas puffs (a) and the gas feed termination.

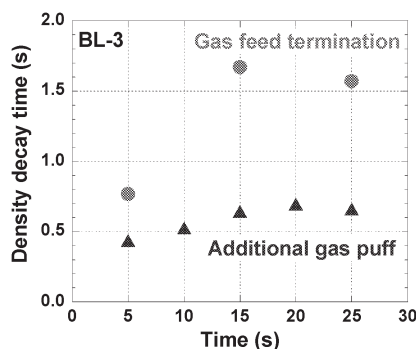


Fig.2 Density decay time in cases of the gas puff and the gas feed termination. The plasma is heated by NBI of which beam direction is CCW.

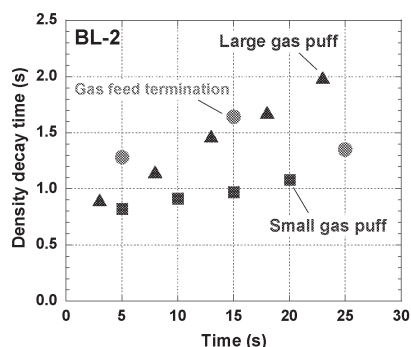


Fig.3 Density decay time in cases of the gas puff and the gas feed termination. The plasma is heated by NBI of which beam direction is CW.

Reference

- 1) Sakamoto, M. et al., J. Nucl. Mater. 313, (2003) 519.