## §45. Wall Recycling Study Using Pulsed Gas Puffing during a Long Duration Discharge in LHD

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The achievement of the stable steady state operation (SSO) is one of the requirements for the future fusion reactor. Understanding of the global wall recycling is critical in achieving the SSO. In this time, we investigated the wall recycling properties of long duration discharges of NBI heated hydrogen plasma using pulsed gas puffing (i.e. dynamic condition).

Figure 1 shows the time evolution of the decay time of the line averaged electron density $\overline{n}_e$ just after gas puffing in NBI discharges. The direction of NBI is clockwise (CW). The value of $\overline{n}_e$ of the background plasma is about $1 \times 10^{19}$ $m^{-3}$. The gas puffing was carried out at the interval of 5 s. In the case of large gas puffing, the density decay time, $\tau_d$, increases with time and it becomes twice in the period from t = 5 s to 25 s. The increment of $\overline{n}_e$ due to gas puffing is about 25 %. On the other hand, in the case of small gas puffing, $\tau_d$ only slightly increases. The increment of $\overline{n}_e$ due to the gas puffing is about 7 %. It is found that there exists a big difference of $\tau$ between large and small gas puffings.

Figure 2 shows a comparison of $\tau_d$ between CW-NBI and CCW-NBI discharges. In both discharges, large gas puffing, i.e. ~25 % increment of $\overline{n}_e$, was carried out. In the case of CCW-NBI discharge, $\tau_d$ does not change so much and it seems to be almost constant during the discharge. In the case of CW-NBI, the result is the same as Fig.1. It is found that there also exists a big difference of $\tau_d$ between CW-NBI and CCW-NBI discharges.

The decay time of $\overline{n}_e$ just after the gas puffing means the effective particle confinement time $\tau_p^*$ and it is a good scale for the evaluation of the wall recycling, since it is defined as the following equation:

$$\tau_p^* \equiv \tau_p/(1-R),$$

where $\tau_p$ is particle confinement time and $R$ is a recycling coefficient. The density decay time depends on both particle confinement time and a recycling coefficient. It is expected that $\tau_p^*$ increases with time, since $R$ increases with time. Actually, increase in $\tau_p^*$ with time was observed in TRIAM-1M [1]. On the other hand, it was also observed that the density decay time just after gas puffing did not change during a one-minute discharge which was sustained by lower hybrid current drive in TRIAM-1M [1]. This result is similar to the results of small gas puffing and CCW-NBI in LHD. The difference of $\tau_d$ in Fig.1 and Fig.2 seems to be an important key to understand the mechanism of the wall recycling in the case of the dynamic condition. Through a comparison of results between TRIAM-1M and LHD, the detailed investigation will be done.

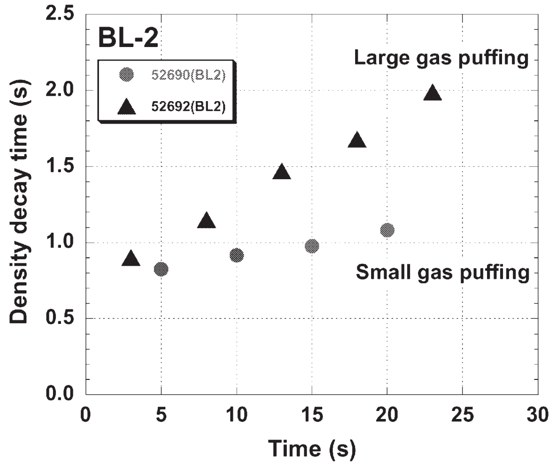


Fig.1 Time evolution of the density decay time just after gas puffing in CW-NBI discharges. Closed circles are data in the case of the density increment of about 7% and closed triangles 25%.

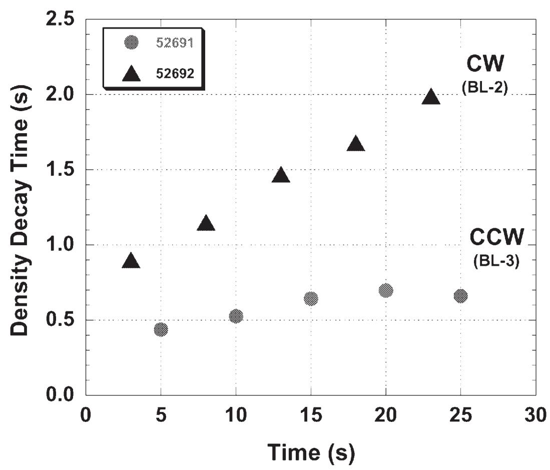


Fig. 2 Comparison of the time evolution of the density decay time between CW-NBI (closed triangles) and CCW-NBI (closed circles) discharges.

Reference

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