§2. Mitigation of Heat and Particle Loads to Divertor with High Z Gas Puffing in LHD

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Considering future fusion reactors, the heat load to a divertor have to be mitigated. One of the ideas to do this is a dissipation of the heat flux to the divertor as a radiation at an edge plasma. So far, impurity gas puffing to enhance the edge radiation was conducted in several tokamaks and LHD.

The ratio of the radiation to the heating power should be as large as possible. Low Z gases such as neon have been used on LHD for radiatation enhancement at the edge resion. However, the ratio in LHD is only 30% at most. In order to increase the radiation, we tried radiation enhancement with high Z gas in the core resion where radiation volume is larger than edge region. On the other hand, optimization of amount of gas puffing is necessary not to degradate the confinement.

Figure 1 shows a discharge with Kr puffing at t =3.4 s. Since a gas puff vulve locates far from the vacuum vessel, the Kr gas gradually flows into the plasma. Hence the radiation gradually increases. Even after Kr puffing, the decrease in the stored energy is only less than 10% and the electron density is maintained almost the same level. The decrease in the temperature is mainly outside the LCFS and the pressure decreased inside the LCFS is only less than 10%. The ion saturation current decreased down to 1/3 and it is confirned that the particle load is suppressed with Kr puffing. However, the final ratio of the radiation bottom out at 30%, which is almost the same level as results with Ne puffing.

As for radiation resion, we measured the radiation profile with an AXUVD array as shown in Fig. 2. The channel 1 and 20 are edge chords, while channel 10 is the central one. In this discharge, Kr is puffed in first and then Ne puff follows. Peak of the emissivity of Ne is at 10-50 eV and those of Kr are at 1-5 eV and 200-400 eV. With combination of Kr and Ne, the radiation region is expected to be expanded wider. The radiation profile after Kr puff is peaked profile (t =3.6 and 3.8 s). After Ne puffing at t =3.8 s, the radiation at the edge region increases (t =3.9 and 4.1 s). This change in th radiation profile consists with dependence of emissivities on the electron temperature of Kr and Ne. Even so, the ratio of the radiation to the heating power is still 30%.

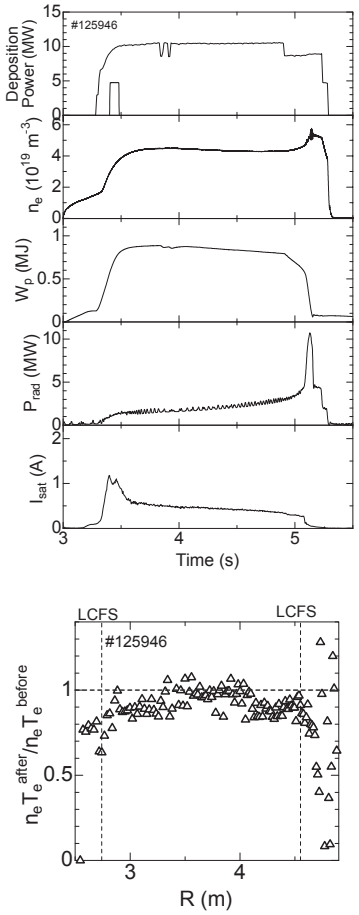

Fig. 1: A discharge with Kr puffing. The Kr is puffed at t=3.4 s. The electron pressure profile after Kr puffing normalized by that before puffing.

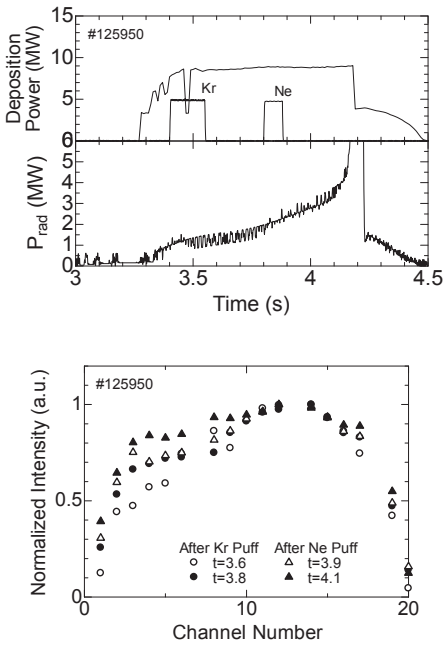

Fig.2 : Combination of Kr and Ne puffing. Normalized Intensity profiles measured with an AXUVD array.