§4. T_e-and n_e- Measurements Using He I Line Intensity Ratios in High Density Plasmas

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He I line intensity ratios for T_e- and n_e- measurements in high n_e plasmas with a presence of hot electrons are calculated using new atomic data [1,2]. The He I line intensities for 504.8 (2^1P-4^1S), 501.6 (2^1S-3^1P), 492.2 (2^1P-4^1D), and 471.3 (2^3P-4^3S) [nm] are obtained by the collisional radiative model [3,4] including the effect of hot electrons.

T_e-measurement using 492.2/471.3 [nm] line intensity ratio is performed in the low density ($n_e \approx 10^{11}$ cm^{-3}) helium discharge of NAGDIS-I linear device [5]. The line intensity ratio and the T_e are shown in Fig. 1 (a) and (b), respectively. In the low base pressure with filling gas flow below 10 ccm, the plasma has mono-T_e, and the results of line intensity ratio has a good agreement with the Langmuir probe measurement. In the higher base pressure, hot electrons with T_{eh} = 20 - 40 eV and the abundance α = 5 - 15 % appear. Then, the T_e for bulk component T_{ec} become low $\leq$ 10 eV. The line intensity ratio calculated from T_{ec}, T_{eh}, and α is consistent with the experimental data of line intensity ratio. This result demonstrates the T_e-measurement with the presence of hot electrons and the feasibility of the detection of hot electrons.

In high n_e plasmas, population density of the excited states are affected by the finite population densities of the other exited state. Then, the rate coefficients for line emissions have n_e-dependence especially in the density region of n_e = 10^{11}-10^{15} cm^{-3}. Hence, line intensity ratios are calculated with the collisional radiative model, which enables us to estimate the influence of 'high n_e effects'. Figure 2 (a) and (b) shows the n_e- and T_e-dependences of line intensity ratios. The 504.8/471.3 [nm] line intensity ratio has strong T_e- but weak n_e- dependences, which is suitable for T_e-measurement. n_e-measurement are available by actively utilizing n_e-dependence of line intensity ratio. The ratio of 492.2/504.8 [nm] has strong n_e- but weak T_e- dependences, which is suitable for n_e-measurement. The simultaneous T_e- and n_e- measurements will be a powerful tool for the investigation of fusion edge plasmas. Details in this work will be presented in NIFS Res. Rept.

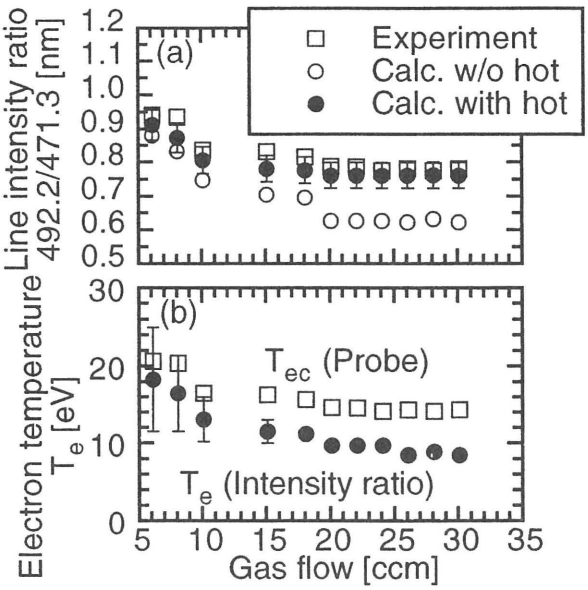

Fig. 1 T_e-measurement and the detection of hot electoron in NAGDIS-I.

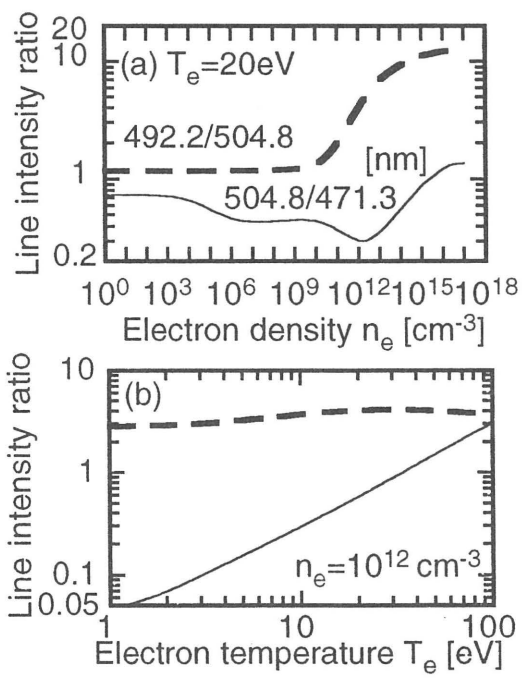

Fig.2 (a) n_e- (b) T_e- dependence of line intensity ratios

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