

## Electric field at plasma-facing wall for double electron temperature

Y. Tomita<sup>1</sup>, G. Kawamura<sup>1</sup>, M. Ueno<sup>2</sup>, N. Ohno<sup>2</sup>, Z.H. Huang<sup>3</sup>, Y.D. Pan<sup>3</sup>, and L.W. Yan<sup>3</sup>

<sup>1</sup> National Institute for Fusion Science, 322-6 Oroshi-cho, Toki 509-5292 Japan

<sup>2</sup> Graduate School of Engineering Nagoya University, Furo-cho, Chikusa-ku, Nagoya, 4648603, Japan

<sup>3</sup> Southwestern Institute of Physics, P.O. Box 432, Chengdu 610041, Sichuan, China

\* Email: tomita@nifs.ac.jp

Electric field at a plasma-facing wall is studied analytically in the case of electrons with double temperature. The models are as follows: *a*) magnetic field is applied to the surface normal, *b*) velocity distribution function of ions at the entrance of Debye sheath is assumed to be shifted-Maxwellian, *c*) the potential at the plasma-facing wall is floating. The Boltzmann relation to the electron distribution and the flux and energy conservation in the Debye sheath of ions give the each density as a function of the electrostatic potential. By using the Poisson's equation the local electric field inside the sheath is expressed by the local electrostatic potential.

In the case of electrons with high-energy component such as double temperature, the potential drop inside the sheath is enhanced in order to prevent the electron current with high energy under the floating condition. The increment of the potential drop -  $\phi_w$  makes the electric field at the wall  $E_w$  increase. In Table 1 the increases of -  $\phi_w$  and  $E_w$  are shown for the cases of  $T_i = 0$  and  $n_{eh} / n_{se} = 0.01, 0.03$  and  $T_{eh} / T_{ec} = 10, 30$ , where  $T_i, n_e$  and  $T_e$  are the ion temperature, electron density and temperature at the sheath entrance, respectively. The suffixes *c* and *h* indicate the cold and hot component of electrons, respectively. The quantity  $n_{se}$  is the electron density at the sheath entrance and -  $\phi_{w_0}$  and  $E_{w_0}$  are the values in the case of  $n_{eh} / n_{se} = 0$ .

The effect of finite ion temperature is shown in Fig. 1, where the change rates of  $E_w$  to the value of  $T_i = 0$  are drawn. The solid, long dashed, short dashed and dotted lines are  $(n_{eh} / n_{se}, T_{eh} / T_{ec}) = (0.01, 10), (0.01, 30), (0.03, 10)$  and  $(0.03, 30)$ , respectively. The changes due to finite ion temperature are few percentages for the case of lower ion temperature than that of cold component.

These results might be available to the study of the phenomena near the plasma-facing wall such as release of dust particle from the wall [1] and the reflection of dust particles near the wall.

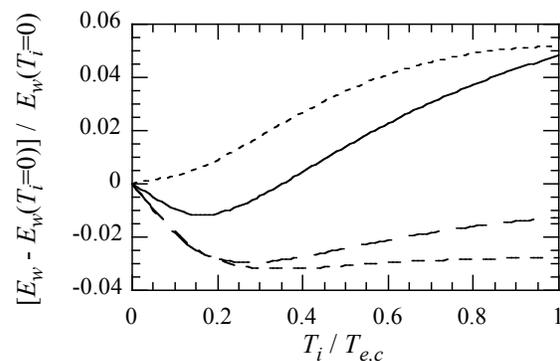


Fig. 1 Effects of finite ion temperature to the electric field at the plasma-facing wall.

Table 1. Effects of hot electron component: wall potential drop  $\phi_w$  and electric field  $E_w$

| $n_{eh} / n_{se}$ | $-\phi_w (T_{eh}/T_{ec}=10)$<br>/ $-\phi_{w_0}$ | $-\phi_w (T_{eh}/T_{ec}=30)$<br>/ $-\phi_{w_0}$ | $E_w (T_{eh}/T_{ec}=10)$<br>/ $E_{w_0}$ | $E_w (T_{eh}/T_{ec}=30)$<br>/ $E_{w_0}$ |
|-------------------|---|---|---|---|
| 0.01              | 1.167   | 1.578   | 1.097                                   | 1.308                                   |
| 0.03              | 1.915   | 10.76   | 1.443                                   | 2.859                                   |

[1] M. Ueno, N. Ohno, Y. Tomita and G. Kawamura, this Workshop.