§11. Dielectronic Recombination Rate Coefficients from O^{5+} Ion to O^{4+} Ion

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LHD plasma has recombining plasma phase when it ends. OV spectral lines are measured as one of monitored lines in LHD plasma. In order to diagnose LHD plasma with OV lines, we are interested in constructing a collisional-radiative model (CRM) for OV in recombining plasma. Dielectronic recombination (DR) is one of important processes in a plasma and the state selective recombination rate coefficients are necessary to construct a CRM. Therefore we have calculated DR rate coefficients from the ground state of O^{5+} ion to the excited states of O^{4+} ion.

We carried out detailed calculations of radiative transition rate A_r and autoionization rate A_a for the intermediate states $2snl$, $2pnl$ with $n = 2-8$ and $l \leq (n-1)$, and $3snl$, $3pnl$, $3dnl$ with $n = 3-6$, $l \leq (n-1)$. The atomic energy levels and bound-state wave functions were otained by using the atomic structure code of Cowan. The perturbation theory method (MZ code) was also used for calculating energy and radiative transition probabilities.

DR rate coefficient for an excited states f of O^{4+} is calculated as

$$\alpha_d(i,f) = \sum_m \frac{g(m)A_r(m,f)A_a(m,i)}{\sum_j A_a(m,j) + \sum_k A_r(m,k)} \exp(-\frac{E_s(m)}{kT_e}),$$

where m indicates intermediate doubly excited states, i and j indicate the ground state and possible states of O^{4+} for autoionization from m states, f and k indicate excited states of O^{5+} ion, and $g(m)$ is statistical weight of m state.

Figure 1 shows n dependences of the DR rate coefficients of final excited states $2lnl'$ of O^{4+} ion at low temperature. For small n states, $\alpha_d(i,f)$ is affected by enhanced A_r due to configuration mixing between $2snl$ and $2pnl$ states. For example, mixing coefficients are large for 2s3d+2p3p or 2s6d+2p5p+2p4f configurations and $\alpha_d(i,f)$ of 2s3d and 2d6d are enhanced at low temperature, compared with $2s5l$ states. At high temperature, transitions through $3lnl'$ dominate the rate coefficients and such feature caused by configuration mixing dissappears. This phenomenon is also seen in the DR rate coefficients of Ne^{6+}. The DR rate coefficients of $2s3l$ and $2s5l$ states are enhanced by configuration mixing, comared with $2s4l$ and $2s6l$ states for Ne^{6+} [1].

Figure 2 shows total DR rate coefficients and our results agree well with Chen's results [4].

We have constructed a CRM for OV including these calculated DR rate coefficients. Preliminary results of the CRM show the similar feature for electron density dependences of the population densities to those of the other Be-like ions such as NeVII and FeXXIII. We will improve the CRM model.

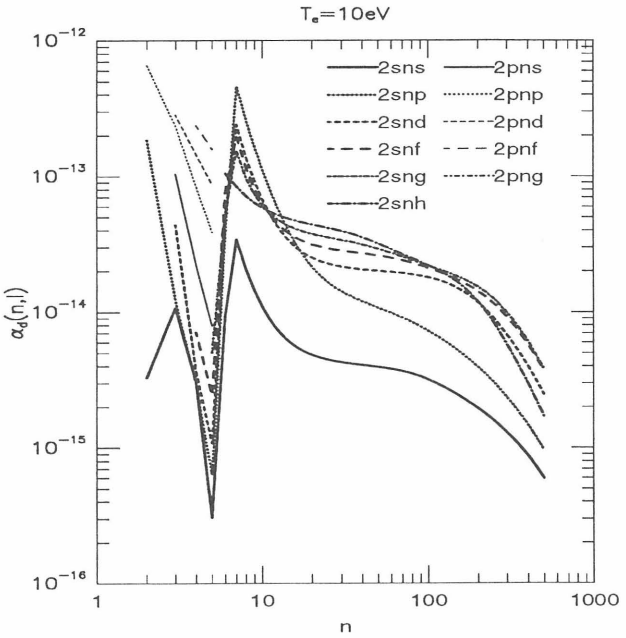

Fig. 1: Prinicipal quantum number dependences of DR rate coefficients of $2lnl'$ states of O^{4+} ion at $T_e = 10$eV.

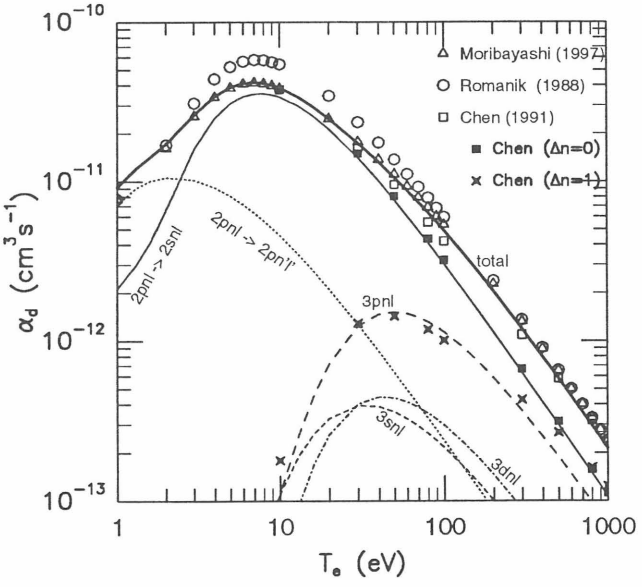

Fig. 2: Electron temperature dependences of total DR rate coefficients of O^{4+} ion with other works[2, 3, 4].

References
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