§22. Multi-Electron Capture Cross Sections Between Highly Charged Ions and Molecules

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The electron capture processes in collisions of slow highly charged ions with neutral atoms and molecules is of great importance not only in basic atomic physics but also in applied fields such as fusion plasmas and astrophysics. In such processes, several electrons may be transferred into multiply excited levels of highly charged ions with significantly large cross sections (process (1)), and finally the product ions are stabilized through ejections of electron(s) or photon(s) (process (2)),

$$A^{q+} + B \rightarrow A^{(q-j)+*} + B^{j+} \quad (1)$$

$$\rightarrow A^{(q-i)+} + B^{j+} + (j-i)e + n(h\nu) \quad (2)$$

where j and i are the number of electrons transferred from target and the degree of the final projectile charge change, and the cross sections for the process (1) and (2) are defined as σ^{j}_{q} and $\sigma^{j}_{q,q-i}$, respectively. Previously we measured the electron capture cross sections in collisions of highly charged ions with rare gas atoms[1),2)], and then proposed a scaling law for representing the charge capture processes systematically[3)].

In this paper, we report the experimental results of the absolute total charge capture cross sections in 1.5qkeV I^{q+} + molecule (H_2, N_2, CO, CO_2, CH_4) collisions. As shown in Fig. 1, the cross section increases as the charge of the projectile ions increases.

Furthermore, it is found that our scaling law[3)], previously proposed for atoms, can also reproduce our molecular data. Here we use the adiabatic ionization potential I for comparison with our scaling law as shown in Fig. 2 where data for rare gas atoms are included.

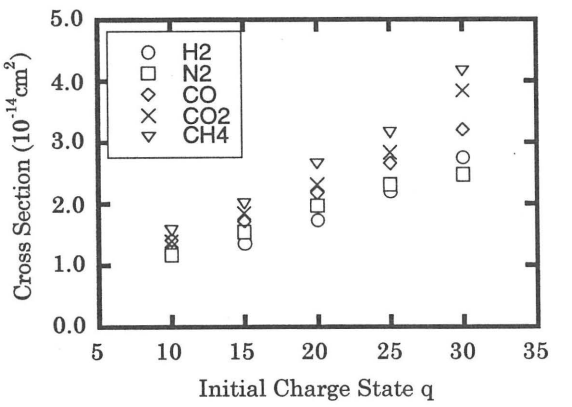

Fig. 1. Absolute total charge capture cross sections v.s. charge of the projectile ions.

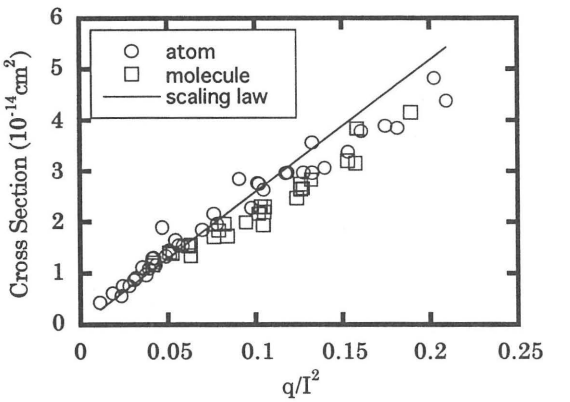

Fig. 2. Comparison with a scaling law[3)].

References

(1) I. Yamada et al., J. Phys. B **28** (1995) L9
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