

§14. A Systematic Study of Electron Scattering Cross-Section by Molecule

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In order to investigate the relation between characters of multi-atom molecules and their electron scattering cross-section, we measured the total cross-section of CF_4 , C_2F_6 , C_3F_8 and $\text{c-C}_4\text{F}_8$ in the energy range from 2 to 3000eV. Chosen molecules are composed of the same atoms and do not cause damage on experimental apparatus. Experimental apparatus is composed of an electron gun, a system of electron lens, a collision chamber (CC), a sub-collision chamber (SCC) and a box collecting electrons (FC), and they have total length of 20cm and diameter of 2.2cm. This apparatus is shielded doubly with Permalloy from the earth magnetic field. The residual magnetic field is 10^{-7}T . Whole system is set in vacuum chamber, which is evacuated by 6-inch diffusion pump with liquid nitrogen trap. The gas pressure of target gas was kept 0.05Pa or less in CC and monitored by a capacitance manometer. The temperature of CC was measured with a thin film element of platinum and used for correction of gas density of target gas. We can obtain amount of target gas effusing from CC to SCC by using scattering current into SCC, and get a substantial thickness of target gas.

Experimental results are shown in Fig.1 through Fig.4. The results of CF_4 agree well with ones compiled by Christophouros¹⁾. Experimental results on the other molecules are very few, and we only found the ones below 20eV by Sanabia²⁾. The energy dependencies of cross-section resemble each other, but the values show differences more than 10% between them. There are four peaks in results of C_2F_6 and C_3F_8 , presumably they are caused by the structure of the end of molecule. At the low energy side in case of cyclo- C_4F_8 , the results by Sanabia shows sharp increasing with decreasing electron energy, but our results

do not show those tendency.

Pirgov³⁾ reported the cross-sections for vibrational excitation. Especially, in case of C_2F_6 , experimental results are so large the cross-sections for vibrational excitation are almost equal total cross-sections and the positions of peaks differ from Sanabia's and ours one.

Except the region below 20eV, the ratio of the experimental results of cross-section is almost proportional to the total number of electrons in molecule.

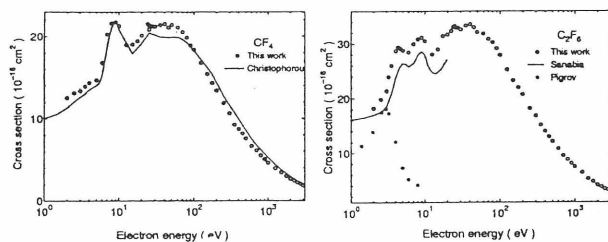


Fig.1 Total electron scattering cross-section of CF_4 (left)

Fig.2 Total electron scattering cross-section of C_2F_6 (right)

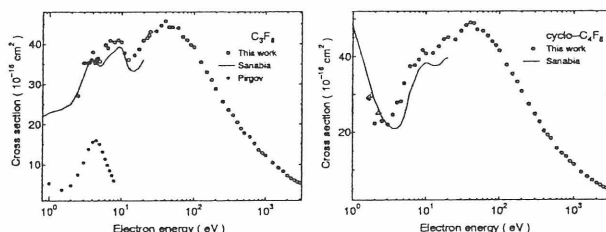


Fig.3 Total electron scattering cross-section of C_3F_8 (left)

Fig.4 Total electron scattering cross-section of $\text{c-C}_4\text{F}_8$ (right)

Reference

- 1) L.G. Christophouros, J.K. Oithoff and M.. Rao, J. Phys. Chem. Ref. Data **25**(1996)1341
- 2) J.E. Sanabia, G.D. Cooper, J.A. Tossel and J.H. Moore J. Chem. Phys. **108**(1998)389
- 3) P. Pirgov and B. Stefanov, J. Phys. B **23**(1990)2879