LOW-ENERGIY AND VERY-LOW ENERGY TOTAL CROSS SECTIONS FOR ELECTRON COLLISIONS WITH NOBLE-GAS ATOMS AND SMALL MOLECULES

M. Kitajima[a], K. Shigemura [a], N. Kobayashi [a], A. Sayama [a], Y. Mori [a], T. Okumura [a], K. Hosaka[a], T. Odagiri [b], M. Hoshino [b], and H. Tanaka [b]

[a]Department of Chemistry, Tokyo Institute of Technology, Tokyo 152-8551, Japan
[b]Department of Material and Life Sciences, Sophia University, Tokyo 102-8554, Japan

Accurate absolute cross sections for electron collision with atoms and molecules provied important informations not only for the fundamental physics of electron collisions but also for many fields such as electron-driven processes in the Earth and planetary phenomena, gaseous discharges, plasmas, and radiation chemistry. Consequences of several interesting phenomena appear in the cross section curves especially at very-low collision energies, such as Ramsauer - Townsend minimums, shape resonances, vibrational Feshbach resonances, and threshold structure due to a virtual state and so on. The low energy behaviors of the electron scattering cross sections are also related to the scattering length which gives zero-energy scattering cross section.

Beam experiments with hot-filament electron sources under the single collision condition have provided accurate cross-sections in a wide range of energies. However, producing an electron beam at energy below a few hundred meV has been a formidable task using the conventional technique based on a hot-filament electron source [1,2]. An alternative method which makes use of photoelectrons produced with the photoioniztion of atoms using high-resolution Synchrotron Radiation (SR) source instead of using the hot-filament electron sources, realized the cross section measurements at ultra-low enrgies down to 10 meV [3,4] in the single collision condition.

In the present report, absolute total cross sections for electron collisions with He, Ne, Ar, Kr and Xe obtained at collision energy from 20 eV down to 10 meV using the technique employing the threshold-photoelectron source with SR are presented [5,6]. The measured cross sections for heavier noble-gas atoms such as Kr and Xe obtained in the single collision experiment were significantly smaller at energies below 100 meV compared to the values reported by the previous swarm studies [7]. Comparison of the measured cross section for noble gas atoms with those of theoretical results are also made. Results obtained for some small molecules will also be presented.

References

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