4 - 6 Dissociative and Nondissociative Ionization Process of Argon Cluster by Electron Impact

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Because of the large equilibrium internuclear distance in single ionized and neutral cluster, the vertical ionization of rare gas van der Waals clusters (Rg_n) by electron impact will be followed by the formation of a high vibrational $(Rg_2)^+$ or $(Rg_3)^+$ ion core. Sequentially, the ions arise from different decay mechanism will be obtained. (1) if the internal energy of high vibrational parent ions are transferred to the continutents' kinetic energy, amount of $(Rg_n)^+$ cluster ions with large momentum may be produced[1]; (2) if the parent neutral cluster is multiply charged and the ion states are intrinsically unstable, the charged fragments with a large recoil energy can be observed through Coulomb explosion; (3) the pure ionization without dissociation can also magnify itself by the narrow momentum distribution. In this report, the $(Ar_n)^+$ ions from pure ionization and the dissociative ionization process with electron impact are identified.

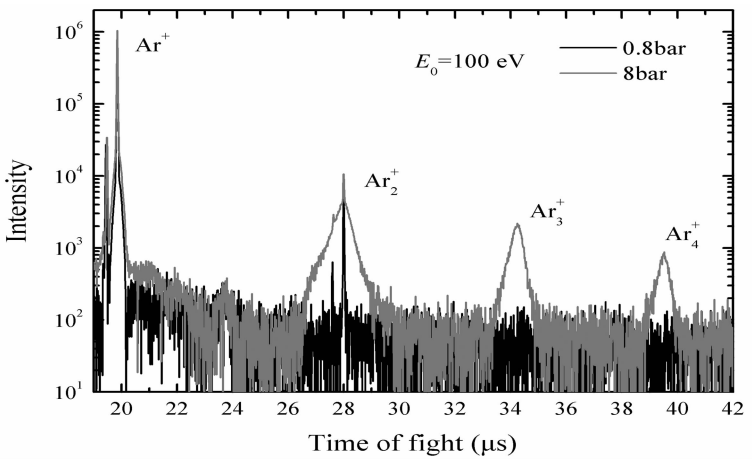

Fig. 1 TOF spectrum for $(Ar_n)^+$ ions.

The product ions induced in the ionization of Ar_n clusters were measured by the Cold Target Recoil Ions Momentum Spectrometer at IMP. Two ToF spectra for argon ions at different stagnation pressures are presented in Fig. 1. The needle part in the peak represents the pure single ionization of the respective neutral target species. Meanwhile, the broaden part indicates the dissociation of parent ions, that is, the corresponding ions arise from the process (1) and (2), and hence get considerable kinetic energy[2]. In addition, the needle parts do not exist in the ToF distribution of trimer and tetramer ions, which means that all Ar_3^+ and Ar_4^+ parent ions prefer to dissociate into smaller size fragments, which is in contrast to the Ar_2^+.

References

[1] O. Danylchenko, et al., Technical Physics Letters, 34(2008)1037.
[2] T. Pflüger, Ph. D. Thesis, Universität Heidelberg, Germany, 2012.