Fragmentation of molecules under 15-30keV negative ions impact

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Synopsis The experimental results are shown for the ionization and dissociation of molecules by impact of negative ions in the 10–30 keV/amu energy range. It is found that the molecule dissociation is more violent in double election loss process of projectile (DL) than in single electron loss process (SL). The ionization and dissociation fractions are found to associate with the momentum of the impacting ions.

Negative ions, and especially their collision processes with molecules, play an important role in a number of areas. In this work, the fragment ions of CF_4 [1] and N_2O[2] are investigated by the impact of 15–30keV H^-, C^-, and O^-.

Figure 1 shows our experiment setup to study the fragmentation in negative-ions–gas collisions.

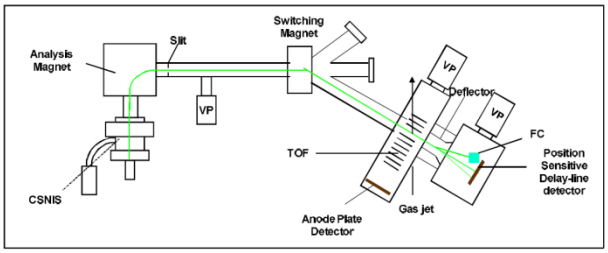

Figure 1. Experiment setup to study the fragmentation in negative-ions–gas collisions

Some conclusions are drawn:

1. It was found that the relative dissociation fractions for DL are larger than those for SL. The degree of fragmentation will become greater with a larger mass number of projectiles at the same impact energy for the same electron loss channel.

2. The ionization and dissociation fractions are found to associate with the momentum of the impacting ions(Figure 2), like those of N_2O[2], SF_6[3].

3. By analyzing the peak slopes of different ion pairs in the coincidence spectra of two fragment-ions, we can give the major dissociation pathways of CF_4^{2+} or $N_2O^{2+}$for 15 keV to 30 keV H^-, C^- and O^- impact.

4. Comparing the ratios of O^++N_2^+/N^++NO^+ in our work with that of Xe^{43+}[4], the ratios with H^- (Figure 3) are almost the same as that with Xe^{43+}, however the values for C^- or O^- are bigger, especially in DL process.

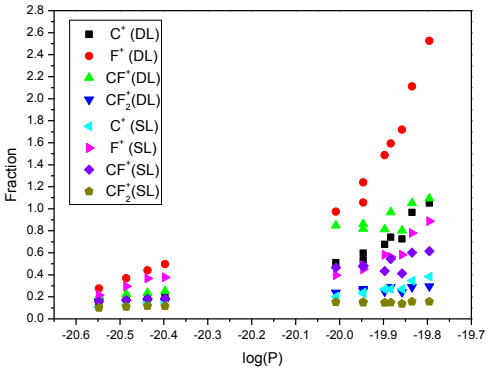

Figure 2. The relative dissociation fractions of CF_4 as a function of the momentum of impacting negative ions. The momentum P is in kg m/s.

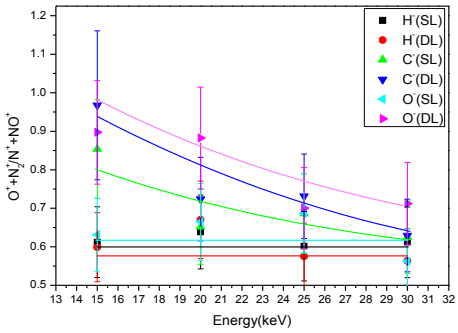

Figure 3. The ratios of O^++N_2^+/N^++NO^+ under H^-, C^- and O^- impact in 15-30keV energy region. The curves are the eye-guide lines.

References

[1] D. Wang *et al* 2016 *J. Phys. B* 49 165201
[2] D. Wang *et al* 2017 *Phys. Rev. A* 95, 012705
[3] X. He *et al* 2016 *Can. J. Phys.* 94 1228
[4] B. Siegmann *et al* www.gsi.de/scirep2006/PAPERS/ATOMIC-PHYSICS-11.pdf

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