# MERGED-BEAM STUDY OF ASSOCIATIVE IONIZATION IN COLLISIONS OF $O^-$ WITH $C^+$, $N^+$ AND $O^+$

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Our merged ion beams set-up[1] has been used to measure the total cross section of the following reactions of associative ionization (AI) involving $O^-$:

$$O^- + C+ \rightarrow CO^+ + e^- \quad (1)$$
$$O^- + N+ \rightarrow NO^+ + e^- \quad (2)$$
$$O^- + O+ \rightarrow O_2^+ + e^- \quad (3)$$

All cross sections appear to be extremely large at thermal energy ($> 10^{-14}$ $cm^2$) and behave like $E^{-1}$ below the detachment threshold of $O^-$. However, subtle differences appear in the range 1-10 eV, where other processes come in competition with associative ionization, i.e. collisional detachment:

$$O^- + X^+ \rightarrow O + X^+ + e^-$$

and transfer ionization:

$$O^- + X^+ \rightarrow O^+ + X + e^-.$$

The second process is expected to be much weaker due to the complete rearrangement needed for it to occur. Depending on the ordering of the ionization potentials, one of these processes corresponds to the dissociation limit of the molecular ion $XO^+$, and hence may compete with associative ionization.

This effect accounts for the difference in the cross sections, and points out to the different nature of the atomic (long-range) and molecular processes responsible for the ionization of the system. Indeed, the molecular picture, in which ionization results from the autoionization of the transient molecular complex, does not favour detachment against transfer ionization. The complexity of the CO and NO systems prevents us from performing direct theoretical calculations, but model calculations should help to clarify the picture.

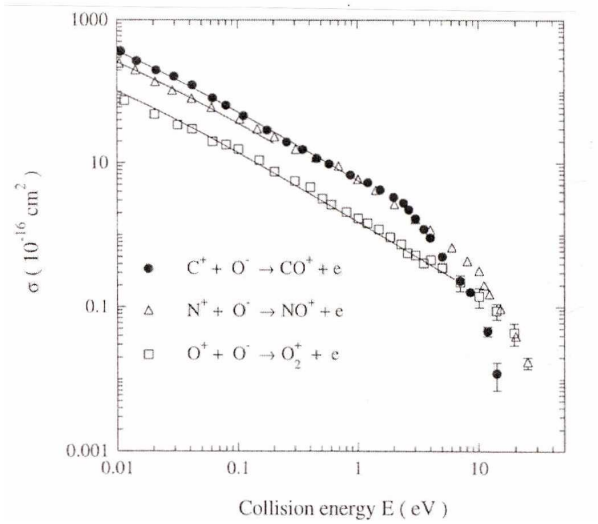


Figure 1. Total cross section for the associative ionization reactions (1)-(3) as a function of collision energy.

References

1. A. Naji, K. Olamba, J.-P. Chenu, S. Szücs, M. Chibisov, F. Brouillard, J. Phys. B: At. Mol. Opt. Phys. **31** 2961 (1998).