Excitation of diatomic carbon molecules by collision

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Synopsis: Dissociative excitation of CH^+, C_2^+, CN^+, SiC^+, AlC^+ collided with an He atom at v=3.6 a.u has been experimentally studied. Branching ratios as well as kinetic energy release measurements were performed and energy distribution associated to the excitation process for all the molecules was constructed. These distributions are found to be sensitively different from a species to another.

Ionization of neutral diatomic species in collision with fast charged projectile leading to dissociation has received lot of attention e.g. [1]. Less has been done on the dissociative excitation and the role of the electronic configuration of the diatomic molecules in the excitation process has been mainly addressed through effects in stopping power.

The measurements were made with the AGAT apparatus at the Orsay Tandem facility. Molecular cationic beams where produced with same velocity (v=3.6 a.u.) and collided under single collision condition with an He atom produced by a gaseous effusive jet. Downstream, the parents and the daughter fragments were electrostatically analyzed and detected in coincidence event by events by a set of silicon detectors. Those were used to measure the mass of the fragments and, thank to their positions in the deflection plane, their charge. By selecting events containing only one charge, branching ratios (BR) of the dissociative excitation were obtained. The silicon facing neutral fragment trajectory was a CCD sensor used as a massively pixelated silicon particle detector (512x512, 25 µm pitch) [2]. From the position of the neutral fragment, impact distributions were constructed for the two fragmentation channels (**A**/B+; **B**/A+). The figure 1 gives an example of such distribution. Under isotropic emission assumption, Kinetic Energy Release (KER) distributions were measured for each dissociation pathway. Typical beam size was in the order of few hundred of micrometers and corresponds, due to the kinematic, to an energy resolution not better than eV. The internal energy following excitation was then constructed as:

$$F(E^*) = \Sigma_i \, BR_i \, x \, (\, KER_i(E) + \Delta H^f_i) \quad (1)$$

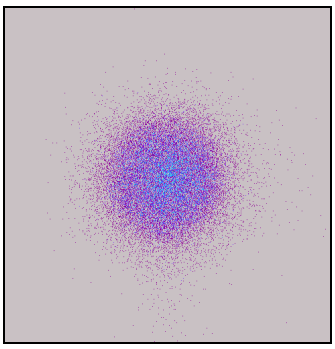

Figure 1. Carbon impact distribution on the detection plan for the channel C/Si+ . The full image is 1.2 x 1.2 cm2.

where i corresponds to the channel (A+/B or B+/A), and ΔH^f is the formation enthalpy of the channel. The table 1 displays the mean excitation energy of the experimental internal energy distributions.

Table 1. Mean internal energies (eV) of diatomic species following excitation by He collision at v=3.6 a.u.

SiC^+	AlC^+	CN^+	CH^+	C_2^+
7.1±.5	5.6±.5	13.7±.5	10.5±.5	8.6±.5

The dispersion is very large. It certainly relies to the first excited states of the diatomic molecules. At the conference we will present a simple model that allows predicting the good ordering of theses mean excitation energies.

References

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[2] *M. Chabot et al, RSI 82,103301, 2011*

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