Fragmentation dynamics of multiply charged molecules under 10-keV electron impact

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In highly ionized media, collisions between ionizing electrons and neutral molecules may result in the formation of variety of positively charged ionic products formed via non-dissociative and dissociative ionization processes involving single as well as multiple ionization. The understanding of such processes is important in wide areas of physical sciences, ranging from planetary and interstellar space [1] to radiation damage of biological tissues [2]. In the complete Coulombic explosion (CE) of molecular ions, if all the fragment ions are detected in coincidence, they are able to provide kinematically complete information about the molecular breakup process [3].

In present work, the electron impact multiple ionization and subsequent dissociation of CO_2, N_2O and SF_6 molecules are studied for 10-keV electron energy using a linear time-of-flight mass spectrometer coupled with a multi-hit position sensitive detector [4,5]. The kinetic energy release (KER) values for various framentation channels observed in these collision events are compared with available experimental and theoretical results reported in the literature. It is observed that pure CE model does not match with our experimental values of KER; whereas the models considering the bent geometrical states of the molecular ions are able to span the whole KER distribution in case of the dissociation channel $C^+ + O^+ + O^+$ of CO_2^{3+} (see, Fig. 1). Further theoretical calculations are required to corroborate the results for N_2O and SF_6.

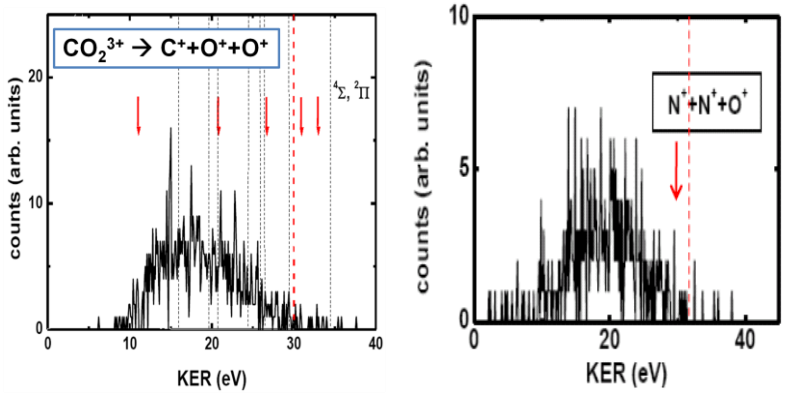

Fig.1: KER distributions of $C^+ + O^+ + O^+$ and $N^+ + N^+ + O^+$ channels observed in 10 keV electron impact on CO_2 and N_2O, respectively. Histogram: present results; Arrow: Earlier reported experimental results for low energy electron and photon impacts; Dotted vertical lines: theoretical predictions (see, Ref. [4,5]).

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