Journal of Physics: Conference Series

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Journal of Physics: Conference Series **388** (2012) 102020 doi:10.1088/1742-6596/388/10/102020

Fragmentation of OCS^{3+} formed by 150 keV Ar^{+} ion impact on OCS

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Synopsis The dissociation of OCS^{3+} formed in ion impact ionization of OCS has been studied using the technique of multi-ion time of flight mass spectroscopy employing 150 keV Ar^{+} ions as projectiles. The coincidence plot reveals several fragmentation channels for the decay of this transient molecular ion with different possible decay mechanisms.

The dissociation dynamics of OCS molecules ionized by impact of 150 keV Ar^{+} is investigated by multi-ion coincidence momentum imaging technique. The experiment was carried out at Low Energy Ion Beam Facility (LEIBF) of Inter University Accelerator Centre (IUAC), New Delhi, India. Various dissociative ionization channels are identified from the double and triple ion coincidence maps.

In this report we focus on the dissociation of OCS^{3+}. Both two fragment and three fragment breakup channels are observed. For breakup into two fragments only OC^{+} + S^{+} channel is detected while for three fragment breakup several channels are seen. Three body dissociation leading to two ions and one neutral may be classified into three types: concerted fragmentation, initial charge separation (S(i)) and deferred charge separation (S(d)) [[1] and the references therein].

The various dissociation channels observed are shown in Table 1 along with the slopes of the coincidence islands as measured from the coincidence maps. Since the m/q value is identical for O^{+} and S^{2+}, the correlation map between S^{2+} and O^{+} gives rise to two different islands depending on the order of arrivals of the ions at the detector.

Table 1. Dissociation channels of OCS^{3+} along with the slope of the coincidence island.

Dissociation channels	Slope
$OC^{+}+S^{2+}$	-2.0
$O^{+}+\mathbf{C}+S^{2+}$	-0.5 and -2.0
$\mathbf{O}+C^{+}+S^{2+}$	-3.7
$O^{+}+C^{2+}+\mathbf{S}$	-3.0
$O^{2+}+\mathbf{C}+S^{+}$	-2.0
$O^{2+}+C^{+}+\mathbf{S}$	-0.5
$\mathbf{O}+C^{2+}+S^{+}$	-4.6

In particular, for the $O^{+}+\mathbf{C}+S^{2+}$ dissociation channel the angle between O^{+} and S^{2+} is around 150^{o} and **C** is always ejected at an angle 85^{o} with respect to the O^{+} ion. The KER distributions have been measured and have mean value 23 eV.

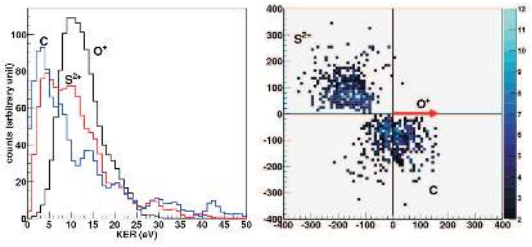

Figure 1. Kinetic Energy distributions of the fragments and momentum imaging for the dissociation of OCS^{3+} into $O^{+}+\mathbf{C}+S^{2+}$.

The slope of -3.7 of the C^{+}:O^{+}/S^{2+} coincidence island may arise from sequential dissociation of $OCS^{2+} \rightarrow O^{+}$:$C^{+}$:**S** and from concerted fragmentation of $OCS^{3+} \rightarrow \mathbf{O}+C^{+}+S^{2+}$. Fragmentation of OCS^{3+} into $O^{2+}+\mathbf{C}+S^{+}$ is a two-body like break-up where O^{2+} and S^{+} move away with equal and opposite momenta leaving C at rest. By analyzing the momentum map of the ionic fragments and undetected neutral along with the slope of the coincidence islands, we conclude that the dissociation pathway leading to the O^{2+} and S^{+} and a neutral C is a two-step process.

References

[1] M. R. Jana *et al* 2010 *J. Phys. B: At. Mol. Opt. Phys.* **43** 215207

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