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Resonant Auger-decay induced fragmentation of glycine molecule

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Synopsis We investigated the fragmentation of glycine molecule induced by resonant Auger-decay following core-shell ionization at different atomic sites by synchrotron light. We show that the dissociation pathways as well as the charge state distributions are modified due to core-level photoionization followed by Auger-decay at the different target atomic sites. The initial states for the dissociation are associated with vacancies in valence or inner-valence shells that are not localized as in core shells. We also compare the molecular dissociation following resonant and non-resonant Auger decay processes to gain insight into the influence on bond cleavage by different ionization mechanisms.

Molecular dissociation has been one of the important topics in studies of molecular interaction with photons. Fragmentation patterns and the final charge distributions bear information on the electronic properties of the initial states of the molecule and even the temporal information of the interaction [1]. We investigated fragmentation of glycine molecule induced by resonant Auger decay processes of core-shell vacancies at different atomic sites. By comparing the scenarios for different target sites of the initial core-level photoexcitation, we are able to gain insight into the various electronic states that leads to the asymptotic ionic outcomes. Moreover, we compare the dissociation pattern and charge distribution for cases with photon energy above and on resonance of K-shell electrons at particular atomic sites. This allows us to gain information regarding the roles the population mechanisms play on determining the final fragment outcomes.

The experiment was carried at the Advanced Light Source (ALS) at the Lawrence Berkley National Laboratory (LBNL). The photon energies were judiciously chosen to core -excite or -ionize the carbon and oxygen atoms in glycine molecule. Photon energy both above and at resonance of the K-edge of the above atomic sites were used. Ion signals were recorded by a velocity map imaging (VMI) spectrometer with a hexanode delay-line detector which enables there-dimensional momentum measurement.

In figure 1, we show the ion time-of-flight (TOF) spectra taken at various photon energies. As seen in these figures, resonant Auger-decay processes lead to different ion yields branching ratios with certain peak enhanced, compared to that by normal Auger-decay. Resonant Auger-decay of core vacancies at C and O results in different charge distribution at particularly the single atomic C, N, O ions with or without hydrogen atoms attached. We will also present the coincidence measurements showing various dissociation channels at different photon energies.

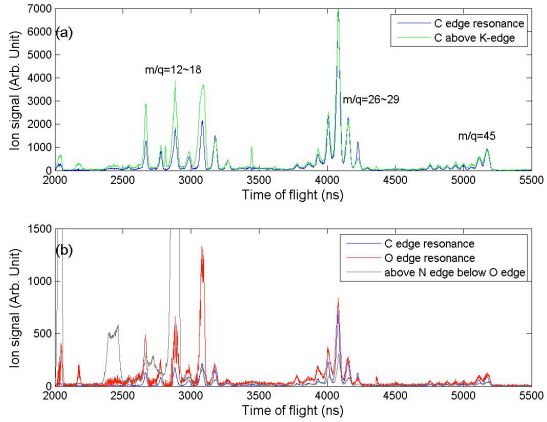

Figure 1. (a) Ion TOF spectra with photon energies at (a) C K-edge resonance and above C K-edge (normalized to the m/q=~26 group) and at (b) O and C K-edge resonance (normalized to the m/q=~26 group); also shown is the spectrum with a photon energy above N but below O K-edge (normalized to N^+ peak in the O resonance spectrum without background subtraction).

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References

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