

## Resonant Raman scattering in 1s-shell photoionization of N<sub>2</sub> molecules

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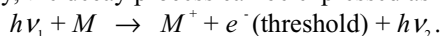
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### Introduction

In inner-shell photoionization of atoms and molecules with light atomic weight, singly charged ions of atoms and parent ions of molecules are possibly observed in coincidence with threshold photoelectrons [1]. Normally, doubly charged ions or more are produced from Auger decays following inner-shell photoionization. Observation of singly charged ions and parent ions discloses participation of radiative decays instead of Auger decays. Namely, the decay process can be expressed as follows,



This process is the so-called continuous radiative resonant Raman scattering [2].

### Experimental method

Experiments were carried out at the undulator beamline BL-2C. The beam line is equipped with a grazing incidence soft X-ray monochromator. A varied space plane grating with 1000 lines/mm was used. The spectral resolution of the monochromator with  $100\mu \times 50\mu$  slits was about 0.15 eV at 400 eV photon energy. Multiply charged ions in coincidence with threshold electrons were measured using a time-of-flight mass spectrometer coupled with a threshold-electron energy analyzer. The energy resolution of the analyzer was estimated to be about 0.03 eV.

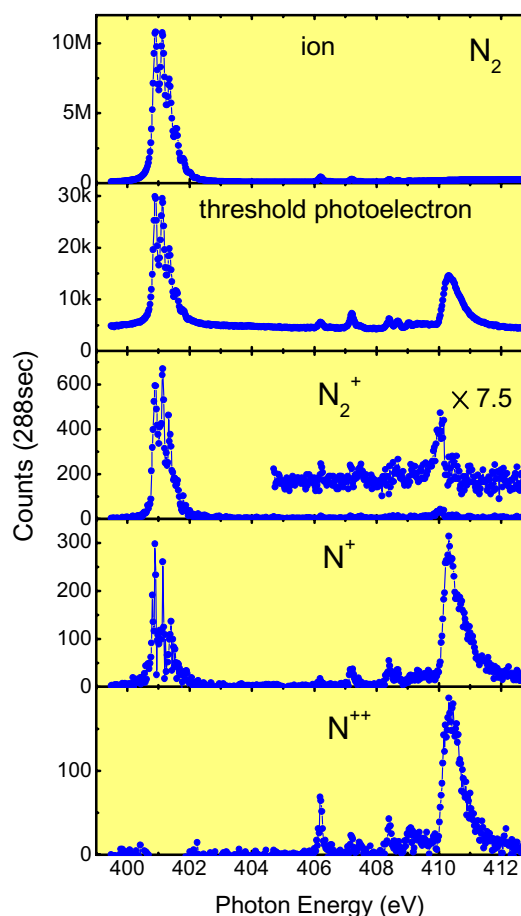
### Results and discussion

Figure 1 shows the yield spectra of N<sub>2</sub><sup>+</sup>, N<sup>+</sup> and N<sup>++</sup> ions in coincidence with threshold photoelectrons near the 1s-shell photoionization region of N<sub>2</sub> molecules. The total yield spectrum of ions correspond to the photoabsorption spectrum, and exhibits some resonance peaks of 1s-shell photoexcitation. The yield spectrum of threshold photoelectrons exhibits a broad and distorted profile due to post-collision interaction (PCI) [3] near the 1s-shell photoionization threshold, including the some resonance peaks.

These resonance peaks and the PCI profile are reflected in the coincidence yield spectra of N<sub>2</sub><sup>+</sup>, N<sup>+</sup> and N<sup>++</sup>, too. It is worth noting that the 1s<sup>1</sup>π\* resonance peak at about 401 eV and the profile due to 1s-shell threshold photoionization at about 410 eV are dominant in these coincidence yield spectra. The PCI profiles in the coincidence yield spectra of N<sup>+</sup> and N<sup>++</sup> originate in Auger decays following 1s-shell threshold photoionization. On the other hand, the coincidence yield spectrum of N<sub>2</sub><sup>+</sup>

exhibits a narrow peak just the 1s-shell photoionization threshold of N<sub>2</sub>. It is conceivable that the peak is due to continuous radiative resonant Raman scattering [2].

Figure 1. Yield spectra of ions, threshold electrons and N<sub>2</sub><sup>+</sup>, N<sup>+</sup>, N<sup>++</sup> in coincidence with threshold electrons near the



1s-shell photoionization region of N<sub>2</sub> molecules.

### References

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