

Inelastic X-ray scattering in 1s-shell ionization of Ne atoms

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Introduction

Inner-shell photoionization of atoms is ordinarily followed by non-radiative Auger decays, which result in the formation of multiply charged ions. In an uncommon case, radiative decays take part in the relaxation as well, which result in the formation of singly charged ions. In 1s-shell threshold photoionization of Ne, the presence of the radiative decays has been found in the coincidence spectrum of Ne⁺ with threshold electrons.

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 2200 lines/mm was used. The spectral resolution of the monochromator with 30 μm × 25 μm slits was about 0.2 eV at 870 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 yield spectra of ions, threshold electrons and Ne⁺, Ne²⁺, Ne³⁺ in coincidence with threshold electrons near the 1s-shell photoionization region of Ne atoms. The yield spectrum of ions, which corresponds to the photoabsorption spectrum, exhibits resonance lines of the 1s⁻¹np Rydberg series and the 1s-shell ionization continuum [1]. The yield spectrum of threshold electrons exhibits those Rydberg series and besides a broadened and distorted peak due to post-collision interaction (PCI) above the ionization limit [2]. The PCI peak can be seen also in the coincidence spectra of Ne²⁺ and Ne³⁺. On the other hand, the coincidence spectrum of Ne⁺ exhibits a narrow peak just the 1s-shell photoionization limit of Ne. In contrast to the coincidence spectra of Ne²⁺ and Ne³⁺, the coincidence spectrum of Ne⁺ is, therefore, free from the PCI effect. It is conceivable that the final state of (threshold electron + Ne⁺) is produced via an inelastic X-ray scattering process, which is enhanced at the threshold.

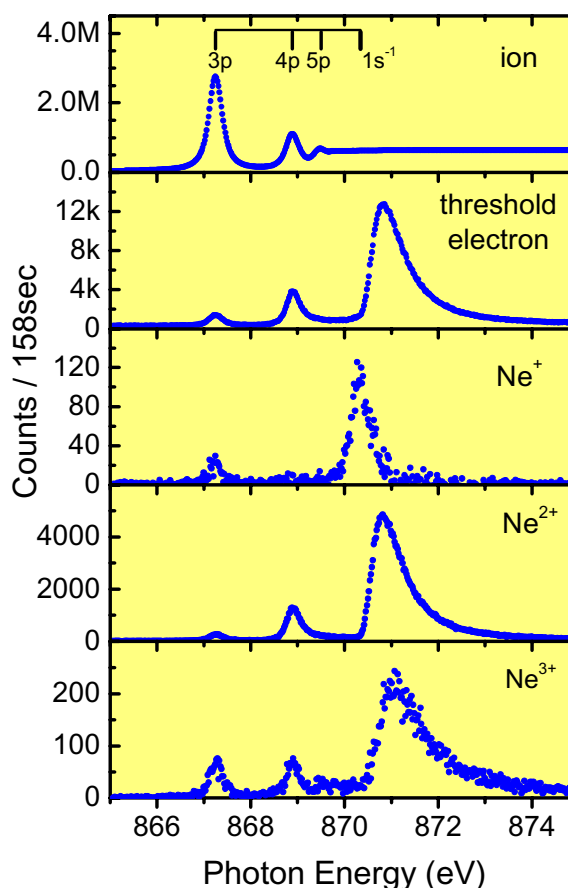


Figure 1. Yield spectra of ions, threshold electrons and Ne⁺, Ne²⁺, Ne³⁺ in coincidence with threshold electrons near the 1s-shell photoionization region of Ne atoms.

References

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