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Development of a toroidal photoelectron spectrometer

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Introduction

The toroidal photoelectron spectrometer has attracted special interest recently, because of high detection-efficiency of electrons. This fact was verified in a toroidal photoelectron spectrometer developed in the Photon Factory [1, 2, 3]. However, the energy resolution of the spectrometer developed remained poor in spite of various improvements. On the basis of these experimental results, re-arrangement and re-adjustment of the spectrometer were performed newly. In the spectrometer refined, the energy resolution could be exceeded 300 ($=E_{path}/\Delta E$). We report on deduction of the high energy-resolution spectra.

Experimental method

Experiments were carried out at the undulator beamline BL-2C. Auger electrons ejected by photoexcitation to the $1\pi^*$ (v=0) resonance of N_2 molecules were observed by the toroidal photoelectron spectrometer refined with two-dimensional position-sensitive detection (2D-PSD) system.

Results and discussion

Figure 1 shows an Auger electron spectrum measured in the refined spectrometer. In the spectrum, the $A\ ^2\Pi_u$ and $X\ ^2\Sigma_g$ Auger electron peaks of N_2 molecules appear clearly. The image of 2D-PSD is composed by four parts of a ring, in which disappears in four directions corresponding to shadows of four poles supporting toroidal electrodes [3]. The image of the ring exhibits heterogeneous distribution in the four parts. It is conceivable that the distribution arises from discrepancy in the arrangement of each electrode. Therefore, the spectrum of figure 1 is derived from accumulation of electrons in one of the four parts. Figure 2 shows an Auger electron spectrum measured in the former spectrometer [3], in the same manner as the spectrum in figure 1. The $A\ ^2\Pi_u$ and $X\ ^2\Sigma_g$ Auger electron peaks of N_2 molecules appear with a somewhat overlap. In the $A\ ^2\Pi_u$ peak, the resolution is estimated to be ΔE = 0.51 eV in the former spectrometer and ΔE = 0.26 eV in the refined spectrometer. It will not too long before the toroidal photoelectron spectrometer has practical application.

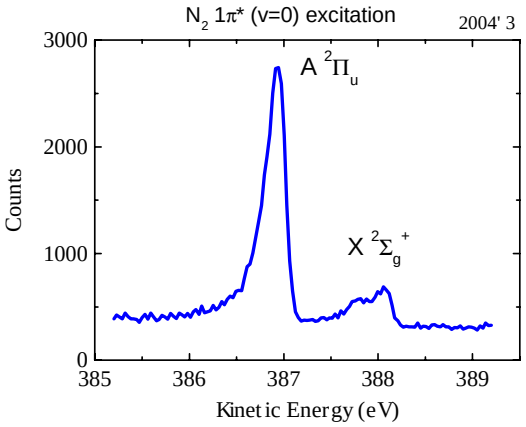

Figure 1. An Auger electron spectrum of N_2 molecules measured by the refined spectrometer.

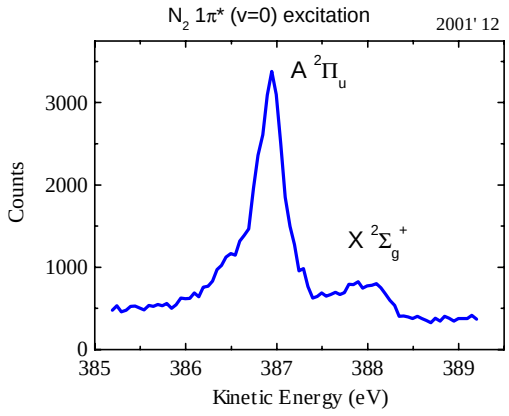

Figure 2. An Auger electron spectrum of N_2 molecules measured by the former spectrometer.

References

[1] T. Hayaishi *et al.*, PF Activity Rep. **16**, 293 (1998).
[2] T. Hayaishi *et al.*, PF Activity Rep. **18**, 288 (2000).
[3] T. Hayaishi *et al.*, PF Activity Rep. **20**, 284 (2002).

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