Performance Test of the Resonant Auger Electron Spectrometer for Atoms and Molecules

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The soft X-ray photochemistry beamline has been constructed for the study of soft X-ray interaction with matter, in particular inner-shell excitation and ionization of atoms and molecules and subsequent processes. Electron spectroscopy for atoms and molecules is one of the most important subjects in this beamline. For examining the performance of an electron analyzer of cylindrical mirror type (CMA; ESA-150-D), an electron gun (EG-412) and a Faraday cup for monitoring the incident electron beam have been attached to the main chamber. First the electron gun was tested under several gas pressures of Ar and Ne of $1x10^{-7}$ Torr to $2x10^{-5}$ Torr, which indicated that the gun works steadily at acceleration energies of 100 eV to 3 keV with beam currents of some μA. A personal computer, Compaq, and an application software for the operation of the CMA were tested using the elastic scattering peak produced from collision between the electron beam and the sample gas. This test showed that the data acquisition of electron spectra works smoothly through this computer system, which had not worked in the previous experiment last March. The electron analyzer itself has been closely examined on energy resolution, a peak profile, magnitude of backgrounds, and other points with respect to the incident electron energy, the electron current, the sample gas pressure, and the nominal resolution. An example of results is shown in Fig.1, which has been obtained under the condition of Ne pressure of $1x10^{-6}$ Torr, the electron energy of 50 eV, the current of 2 nA, and the nominal resolution of 0.1 eV. The peak profile seems slightly asymmetric and its width is about 0.5 eV in Fig.1. Since the experimental width consists of the analyzer resolution and the width of the incident beam, the observed one is appropriate. The setting of a wider resolution in the CMA yielded a less asymmetric peak profile, and the experiment of lower gas pressures and lower beam currents resulted in spectra with lower backgrounds.

Some trials were made for observing Auger electron spectra and/or autoionization spectra of rare gas atoms and N_2. In these trials, the incident beam energy, the beam current, the species of the sample gas, and the nominal resolution were varied, together with tuning of incident beam focus and changes in the structure of the Faraday cup and in the region and the step of the energy scanning. Finally all the trials have failed due to high background noises, which probably originate from wide apertures of the CMA and non-complete collection of the incident beam by the Faraday cup. Spectra of energy loss for Ne were measured at incident energies of 100 eV and so forth, which did not provide clear peaks for 2p to nl excitation owing to high backgrounds. In summary, the resolving ability of the CMA seems good, but it is difficult to suppress background noises into low levels enough to obtain a fine spectrum of inelastic scattering of electrons.

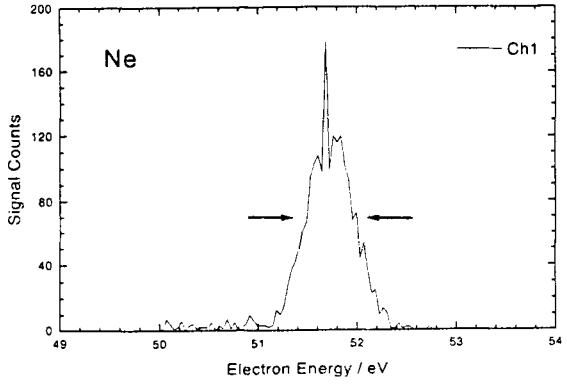

Fig.1: Peak profile of the elastic scattering of electrons for Ne.