Spectrometer calibration with 'standard' Auger spectra

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1. Introduction

These days, Auger electron spectra are obtained in direct mode as digital data under computer control and spectral data are processed after measurement as already common in XPS. In some cases, multi-spectra are used for data processing. The study for the standardization of electron spectroscopy have revealed the degree of scattering in quantification, the origin of the scattering, etc,. The possibility of sharing spectra from many institutes obtained by many different instruments and utilizing those for one's analysis have emerged. Here, the method to calibrate the energy dependence in intensity by using 'standard' Auger spectra within the framework of the COMMON DATA PROCESSING SYSTEM(COMPRO) is presented. By the calibration, one can get the intensity ratio between two different peaks that is not depend on the instrument, and can expect to obtain subtracted spectrum between one's spectrum of the sample and reference spectrum obtained by different instrument.

2. Spectrometer function

Usually, the observed spectra is not same as the energy distribution of originally emitted electrons('true' spectrum) from the specimen. The function which transforms 'true' spectrum into observed spectrum is called a spectrometer function here and the transformation is schematically shown in Fig.1. In the COMPRO, the 'standard' Auger spectra which have E^1 character are registered. To obtain spectrometer function for AES, one load one's spectrum of Au, Ag or Cu and the correspond 'standard' spectrum(Fig.2) and divide one's spectrum with 'standard' one. The divided spectrum(Fig.3) shows the energy dependence of sensitivity. In case of Auger spectrum with fixed retarding ratio(FRR) mode, the energy dependence mainly reflects the energy dependence of the efficiency of electron multiplier. Thus the divided spectrum is fitted by the function of the efficiency of electron multiplier as shown in Fig.3. The fitting parameters represent the character of electron multiplier and can be a barometer of the health condition of the instrument. Once the obtained spectrum is calibrated by this spectrometer function, one can directly compare spectra obtained by different instruments.

3. 'secondary-standard' XPS

For XPS, we registered 'secondary-standard' spectra whose character was examined on the basis of the 'standard' Auger spectra as schematically shown in Fig.4. The double-pass CMA is used as an energy analyzer. At first, Auger spectrum is obtained with this instrument and spectrum is compared with the 'standard' Auger spectrum in order to get the spectrometer function in FRR mode. As the second step, XPS spectrum is measured in FRR mode and transformed into 'true' spectrum. Then

XPS spectrum is obtained in fixed analyzer transmission(FAT) mode (ΔE=const.) and is divided by 'true' spectrum to get the spectrometer function of FAT mode. As the spectrometer function of FAT mode in this double-pass CMA can be expressed as E^{-1}, the XPS spectra obtained by this instrument are registered as 'second-standard' in COMPRO. To obtain spectrometer function for XPS, one's spectrum is divided by the 'secondary-standard' one. The divided spectrum shows the energy dependence of sensitivity and it mainly reflects the character of the input lens of the energy analyzer.

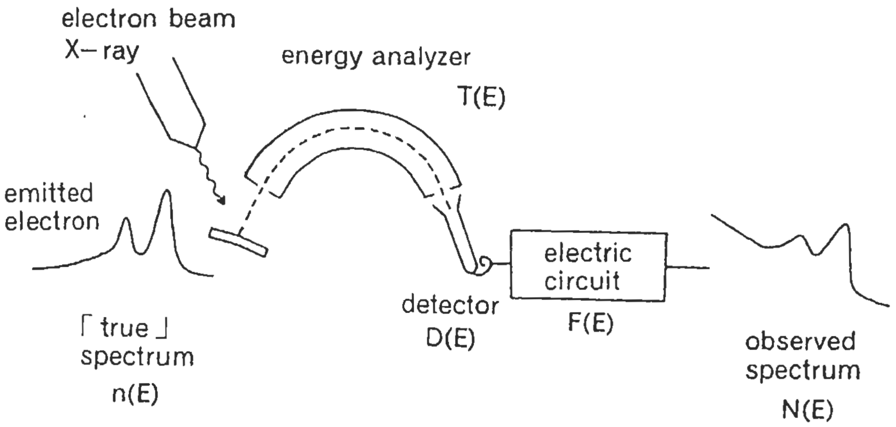

Fig.1 Schematic expression of spectral transformation.

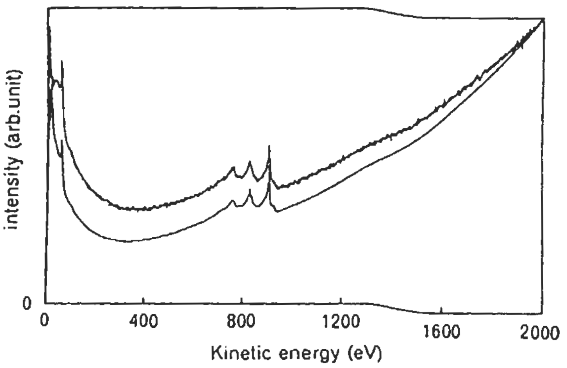

Fig.2 Auger spectra of Cu.

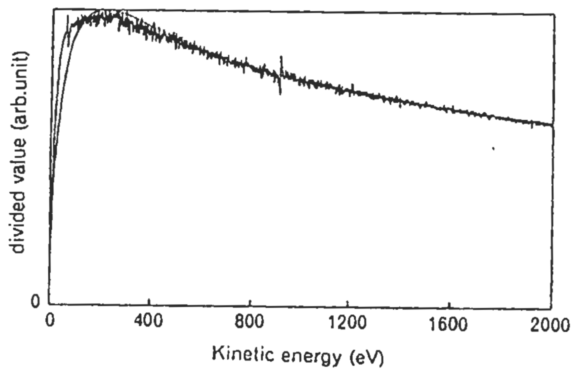

Fig.3 The divided spectrum and the fitting result.

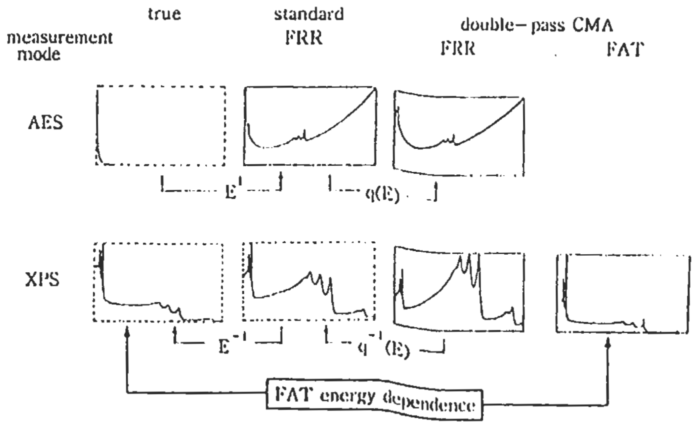

Fig.4 The procedure to get the character of the FAT mode of the double-pass CMA

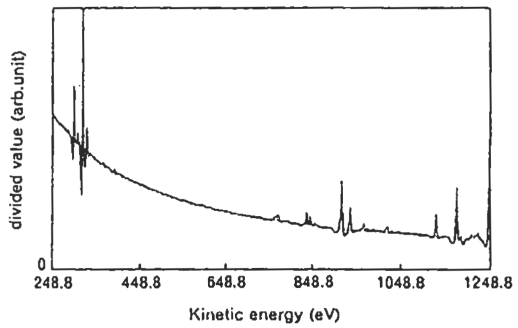

Fig.5 The character of the FAT mode fitted with E^{-1}.