5. Soft-X-ray p A Scattering by Light Element Solids

Koichi Mori

1) Inelastic soft-X-ray scattering by inner-shell electrons in solids of light elements was investigated experimentally.

The condition of inelastic scattering of X-rays by electrons:

$2\pi a_0/\lambda_0 \quad h\nu_0 \gg I$; Compton scattering by A^2-term of Hamiltonian

$2\pi a_0/\lambda_0 \quad h\nu_0 \gg I$; Raman scattering by A^2-term of Hamiltonian

where λ_0 and $h\nu_0$ are the wavelength and the energy of the incident X-rays, a_0 and I are the radius and the ionization energy of the inner-shell electron.

Recently, Ohmura and Suzuki computed the cross section of the scattering under the condition of $2\pi a_0/\lambda_0 < 1$, $10I \geq h\nu_0 \geq I$.

We can roughly estimate the ratio of the contribution of the p·A-term to that of the A^2-term as

$$\frac{\left\langle \frac{p^2}{2m} \right\rangle}{h\nu_0} \cong \frac{I}{h\nu_0}$$

If the energy of the incident radiation is less than 10 times the ionization energy of the inner-shell electron, the contribution of the p·A-term is not negligible and could give an effect of the same order as the A^2-term does to spectra (Fig-1).

The scattering process of A^2-term and p·A-term shows (Fig-2)

2) Experiment and Results

An experiment using the monochromatic intense radiation from an undulator equipped in a syncrotron radiation would be useful to confirm the stated theoretical results.

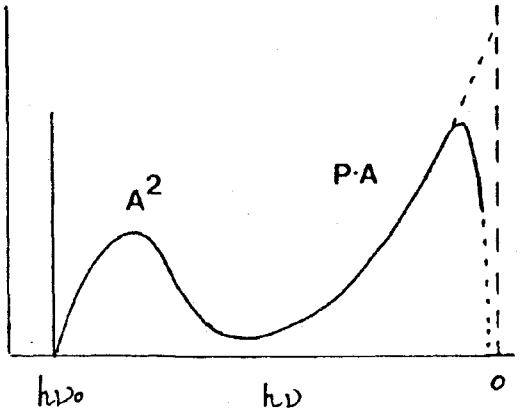
Soft-X-rays generated through an undulator and monochromatized by 10m-GIM were guided onto a beryllium plate of 0.5mm thick. Wavelength of X-rays are 30.6(Å). The angle of scattered radiation is detected at 90° to the polarization direction of incident rays (Fig-3) and detector is a PMT, has good sensitivity for 300nm to 900nm was used with multi channel analyzer.

Raw spectrum including thermal noise of the detector and other back ground signals (Fig-4). Net signals, the disturbing noises subtracted is shown in (Fig-5). Net signals are too small, it should correspond to small scattering cross section.

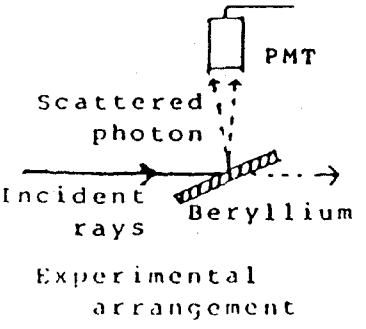
It was not possible to gain sufficient data, but the result gives us possibility in the near future.

上智大学理工学研究科

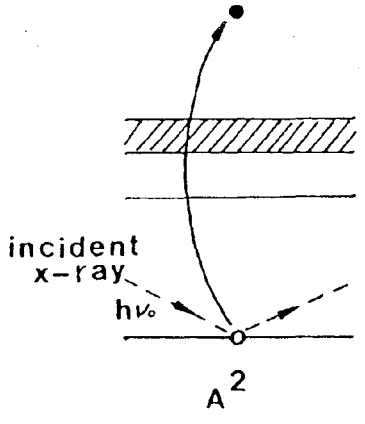
Fig－1

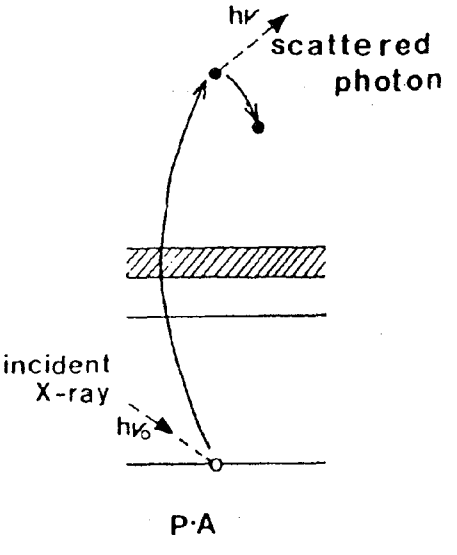


Fig－3

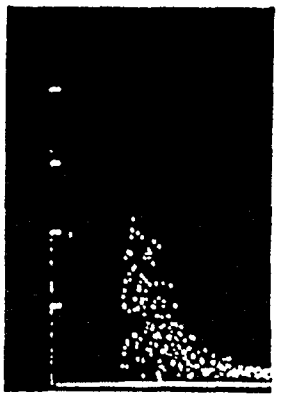


Fig－2





Fig－4



Fig－5

3) References

1) Y.Ohmura and T.Suzuki : J.Phys.Soc.Japan
53 (1984) 2807

2) T.Suzuki : "Advances in X-Ray Spectroscopy"ed.
by C.Bonnelle and C.Mande