Data Base for Surface Loss Functions Derived by Extended Landau Formulation

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According to Landau formula,[1] the energy loss function can be derived from energy loss spectra under the condition that contribution of elastic scattering is negligible. We have proposed an extended landau formulation approach[2] to derive a surface loss function from reflected electron energy loss spectroscopy (REELS)-spectrum under the more comprehensive conditions that elastic scattering as well as inelastic scattering are taken into account.

This approach is based on the use of Monte Carlo simulation to include the contribution of elastic scattering in the Landau formulation. Applying this approach for Au 4f X-ray photoelectron spectroscopy (XPS)-spectrum, we reported that the Au 4f photoelectrons underwent significant surface excitations, revealing that the energy loss function for 4f photoelectrons is quite different from the bulk loss function but very close to the surface loss function.[3] We, therefore, proposed to use this sort of surface loss function for background substraction of XPS-spectrum, enabling more precise source function to be derived.

Figure 1 shows a typical surface loss function of 1 keV electrons in a Au sample. The shape of this loss function is very close to the surface loss function, $-\mathrm{Im}(1/1+\varepsilon)$, that is derived from the bulk loss function, $-\mathrm{Im}(1/\varepsilon)$, assessed from the optical dielectric constant. Applying this surface loss function, we obtained the source function for Au 4f XPS spectrum, which is depicted in Fig. 2(b). Note that the profile (a) is derived from the same Au 4f XPS-spectrum but using the bulk loss function. To extended this approach for the other materials we have been involved in deriving the similar surface loss functions for Si from RHEELS-spectra measured at different take off angles of signal electrons.

Some recent results of the surface loss functions of Si will be also presented.

References

(1) L. Landau, J. Phys. (Moscow), **8**(1944)201

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(3) H. Yoshikawa, T. Tsukamoto and R. Shimizu, Proc. of 11th Pfefferkorn Conference (Scanning Microscopy Pub. Chicago, 1994) in press.

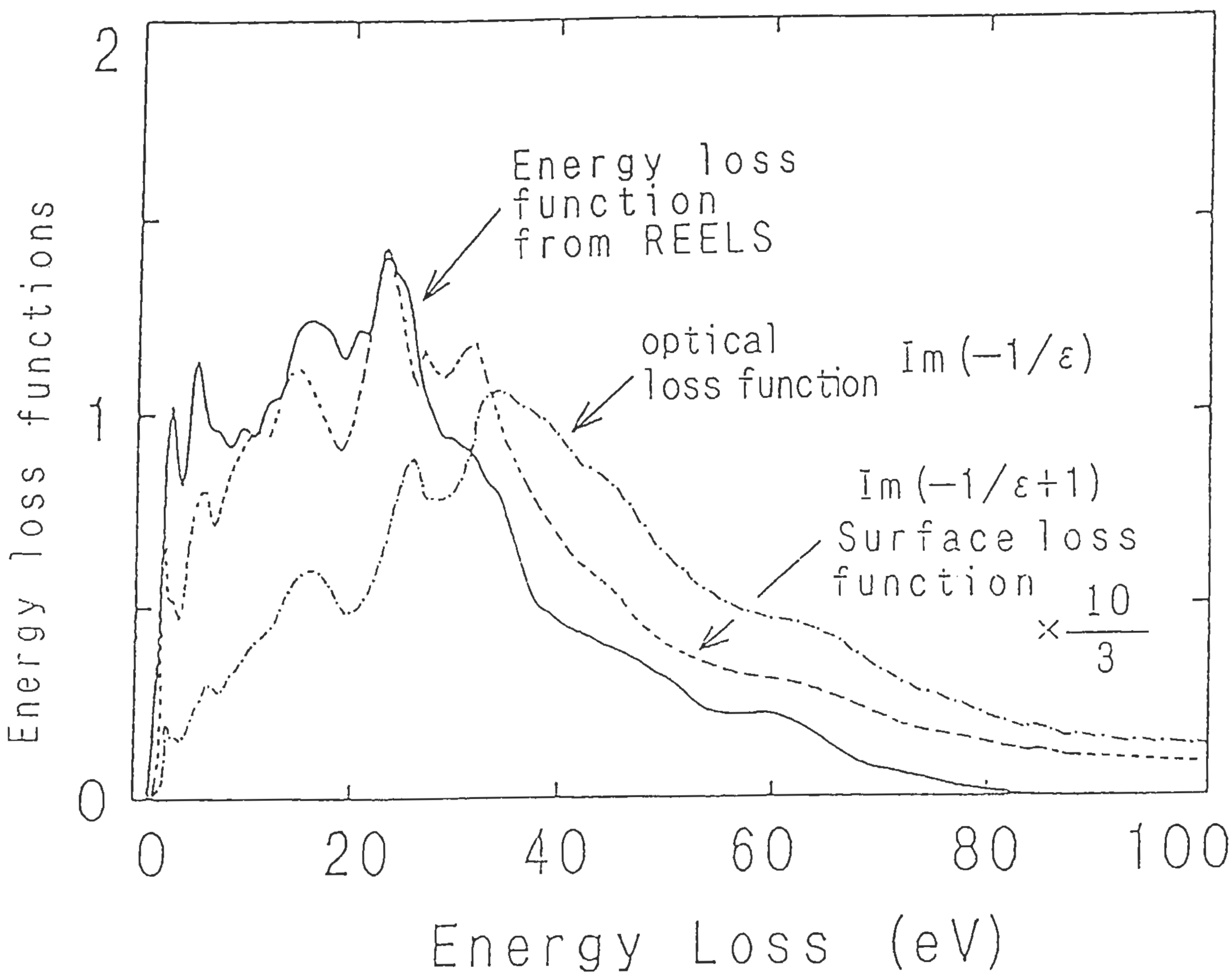

Fig.1 Comparison of the energy loss function with the optical loss function and the surface loss function derived from the optical loss function by Im (-1/ε+1). ——; Energy loss function (Fig.5(a)). ---; Optical loss function Im (-1/ε). ······; Surface loss function Im (-1/ε+1).

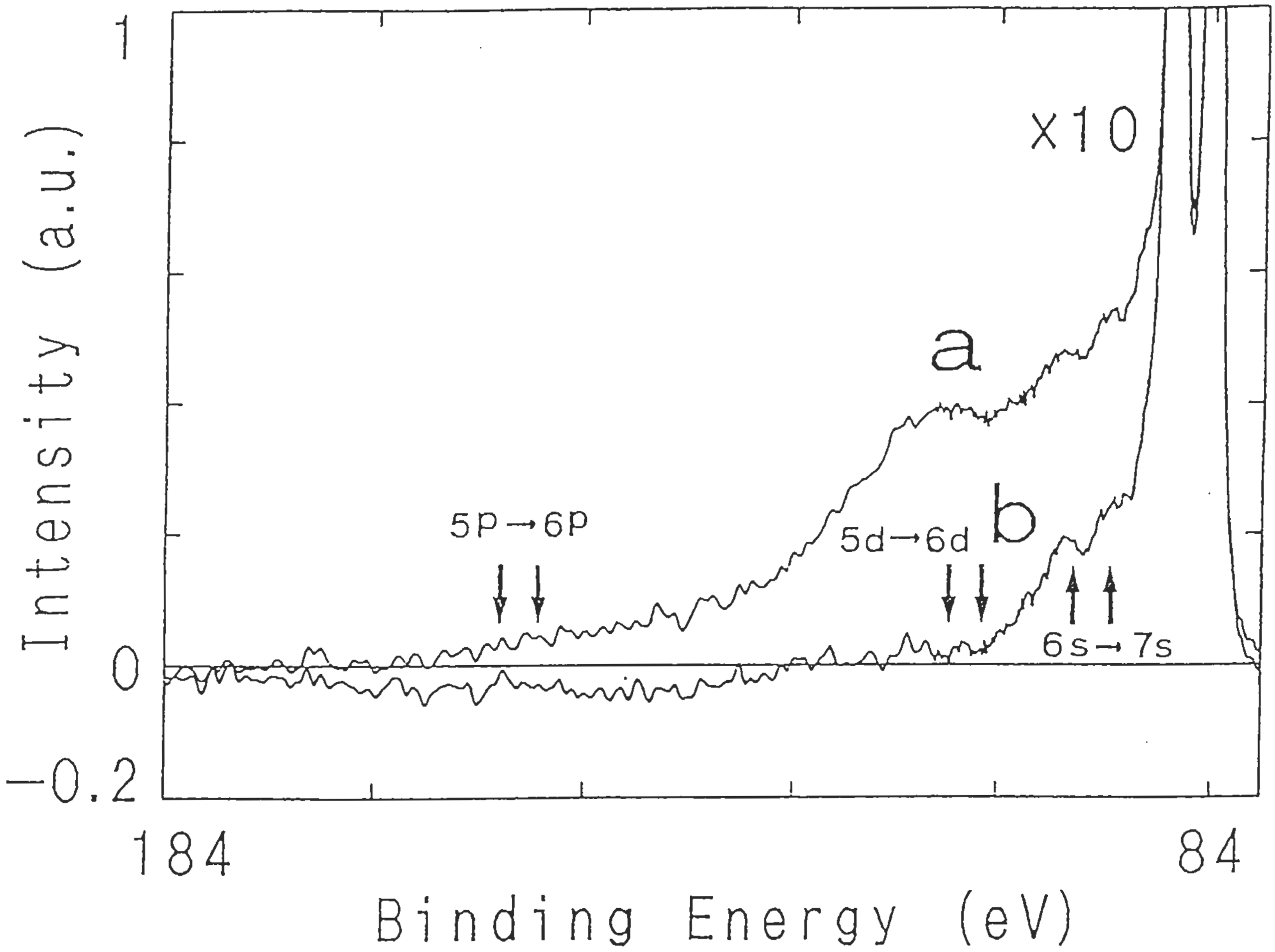

Fig. 2 Au 4f XPS source functions extracted from the experimental data(Fig. 3) by means of Monte Carlo analysis using respectively, theoretical loss function (the dashed line in Fig.1) for curve a, and the energy loss function (the solid line in Fig.1) for curve b. The background spectra are magnified by tenfold relative to $4f_{7/2}$ peak. The arrows display the energy position of shake-up satellites obtained by Herman-Skillman atomic orbital calculation corresponding to the monopole transtions 6s→7s, 5d→6d and 5p →6p.