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Comparison of Glancing Angle EXAFS Extracted from Reflectivity And Fluorescence Modes

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Abstract. *EXAFS extracted from glancing angle fluorescence and reflectivity data are compared after correcting for the anomalous dispersion distortions. Preliminary results show good agreement in the information obtained from the two techniques.*

The glancing angle EXAFS data can be obtained either from the reflectivity at the surface of the sample (reflEXAFS), or from the fluorescence excited inside the sample (fluoEXAFS). The fluoEXAFS is superior to the reflEXAFS for dilute systems, but the reflEXAFS is not subject to the contamination of large angle scattering signal that might affect the fluorescence. Both methods have been employed in qualitative surface and interface studies. Until now, the quantitative analysis of glancing angle EXAFS has been hindered by the anomalous dispersion effect which causes distortions in the EXAFS amplitude and phase [1]. We have developed a simple technique to correct for such distortions in the fluoEXAFS and reflEXAFS. Data from a Au thin film is used as examples to demonstrate the correction.

To obtain EXAFS from any indirect measurement of μ (non-transmission), one can establish a general relation between μ and a function G that describes the measurement, without regard to the specific form of G. That is

$$\Delta G = \frac{dG}{d\mu}\Delta\mu \tag{1}$$

G can be the fluorescence or reflectivity, or any measured function. $\Delta\mu$ stands for the EXAFS oscillation. ΔG is then the oscillation of the measured signal caused by $\Delta\mu$. For the fluorescence, it is convenient to write $G = \mu F$, and F stands for the x-ray intensity inside the film, which is a function of μ and δ. Equation (1) can be transformed into a relation between the fluoEXAFS and EXAFS :

$$\chi'(fluo.) = \chi(1 + \frac{\mu_0}{F_0}(\frac{\partial F}{\partial \mu} + \frac{\partial F}{\partial \delta}\frac{d\delta}{d\mu})) \tag{2}$$

where μ_0 and F_0 refer to the smooth part (no EXAFS) of μ and F, and $\frac{d\delta}{d\mu}$ reflects the relation between β-EXAFS and δ-EXAFS [2]. All of the terms can be calculated from a simple analytic model for the anomalous dispersion [3].

Similar arguments can be made for the reflEXAFS. Replace G by the measured reflectivity R,

$$\chi'(refl.) = \chi\frac{\mu_0}{R_0}(\frac{\partial R}{\partial \mu} + \frac{\partial R}{\partial \delta}\frac{d\delta}{d\mu}) \tag{3}$$

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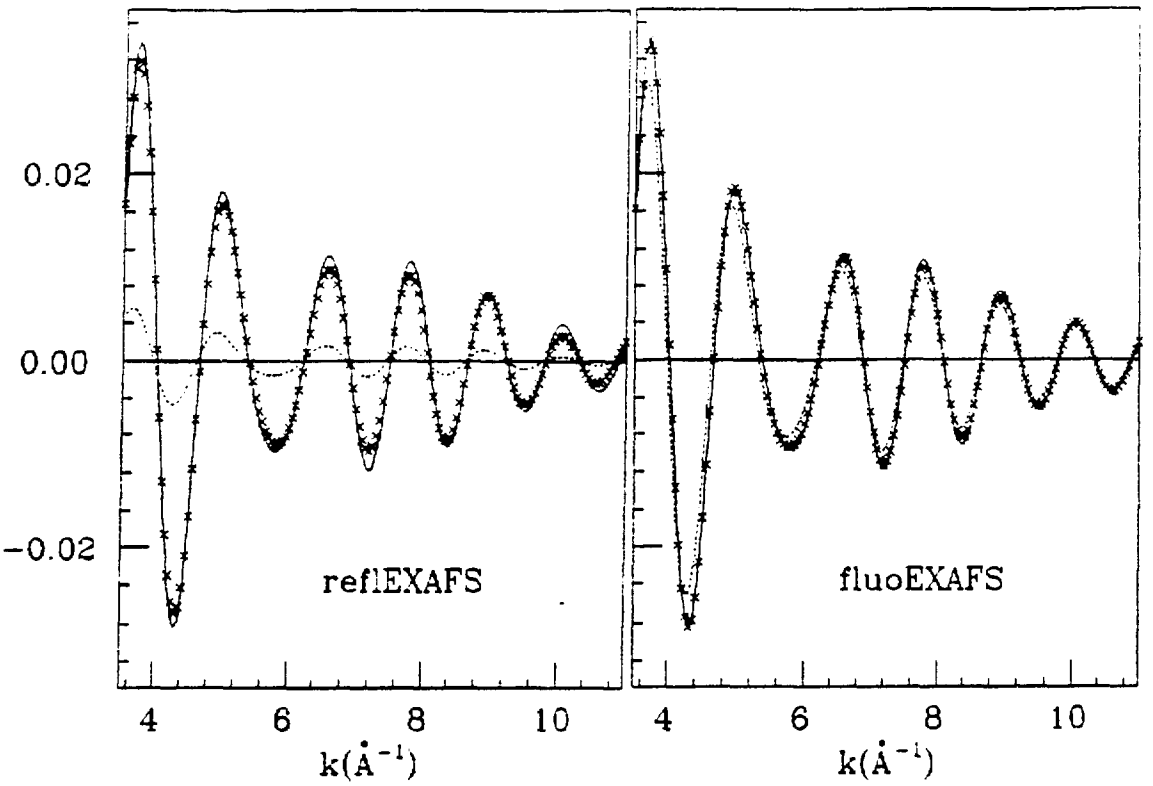

Fig.1 reflEXAFS and fluoEXAFS at 4.5mrad, before (– – –) and after (+++) corrections, compared to Au foil (——).

The fluorescence and reflectivity data from a Au thin film sample as functions of energy were measured at NSLS X-11 station. The first shell fluoEXAFS and reflEXAFS extracted from these data before and after the correction are shown in Fig.1. One can see that after the correction both of the fluoEXAFS and reflEXAFS are in good agreement with the standard (Au foil data) within the experimental error. There seems to be no evidence at this point that the large angle scattering makes substantial contribution to the fluoEXAFS.

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