ABSORPTION CORRECTION OF Fe Lα,β EMISSION FROM IRON OXIDES

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When differential self-absorption occurs through the analyzed wavelength domain (as for the $L_{2,3}$ absorption edges intercepting the measured Fe Lα,β emission bands), the $f(\chi)$ correction factors for each wavelength within the total width of the measured emission bands can be derived from two spectra digitally measured at low and high electron incident energy, successively.

Fe Lα spectra measured from FeO and Fe_2O_3 specimens with a 3 keV and a 7 keV incident energy were normalized and divided channel by channel (Fig.1). Neglecting the absorption effect for the spectrum measured at 3 keV incident energy, the curve $g(\chi) = I(3keV) / I(7 keV)$ gives the fraction of intensity loss in each channel compared with the maximum intensity due to the presence of absorption edges. Applying the $g(\chi)$ curve to the experimental spectrum measured at 7 keV results in a spectrum which would be measured in absence of absorption edges within the analyzed region. In order to determine the intensity generated in the interaction volume, the $g(\chi)$ curve must be scaled to the $f(\chi)$ factor corresponding to the absorption of the characteristic Fe Lα emission in the analyzed iron oxide specimen. Scaling was performed at the wavelength associated with the Fe Lα maximum position for pure Fe, FeO and Fe_2O_3 measured at 7 and 3 keV, successively. The spectra corrected for absorption are shown in Fig.2.

In a first experiment, the generated intensities (total area of the Fe Lα emission bands) were derived from the Fe Lα,β spectra corrected for self-absorption. The calculated weight Fe concentration in FeO using Fe_2O_3 as standard, are given in Table 1.

The absorption correction shifts the maximum peak position of the Fe Lα emission band to a position that represents the actual wavelength of the emission for the analyzed oxide. The $g(\chi)$ curves were scaled to the corrected maximum corrected position and quantitative measurements were repeated. When the total peak area was used as intensity measurement, the error was about +14% but was decreased to –2.5% when only the area of the diagram peak (neglecting the contribution of the low energy band) was used for intensity measurement.

These results show that the accuracy of the analysis improves when the self-absorption correction is applied to the experimental spectra (Figure 2) before measuring the intensities rather than after as done in the conventional approach. However, the use of mass absorption coefficients for pure elements remains questionable as they are expected to be different for the two analyzed oxides with different electronic structure.
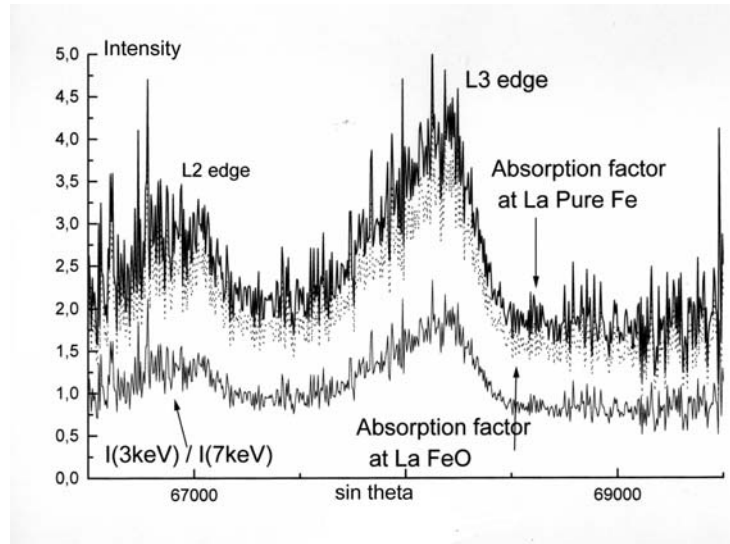
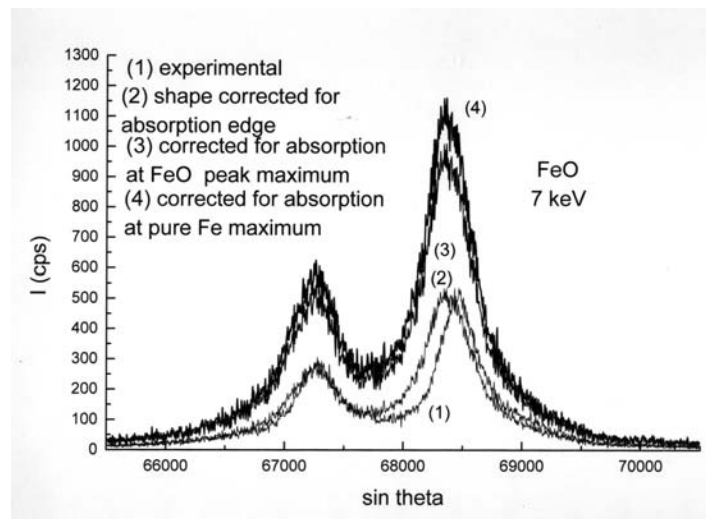Figure 1- Effect on intensity of the presence of absorption edges in the Fe Lα,β spectrum

Figure 2 Experimental Fe Lαβ spectrum from FeO and spectra corrected for absorption

Table 1- Quantitative analysis of Fe in FeO using the Fe Lα emission and Fe_2O_3 as standard (7 keV incident energy)

Processed spectra	Weight Fe concentration C	ΔC/C (%)
Spectrum 1 in Fig. 2	0.680	-12
Spectrum 3 in Fig. 2	0.727	-5.5
Spectrum 4 in Fig. 2	0.748	-2.6

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