

EDX calibration using polynomial fitting over the X-Ray production factors of thin elemental standards

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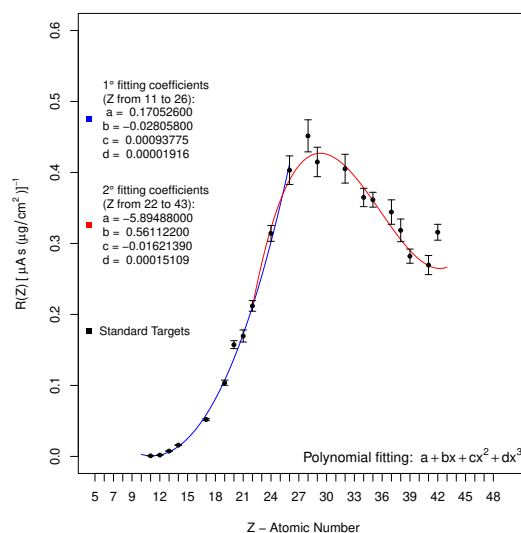
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The uncertainty of the quantitative elemental composition determined by energy-dispersive X-ray spectroscopy (EDX) is connected to the uncertainty of the available standard targets. They define the starting level of the uncertainty for calibrations when they are individually performed for each element. Fixing general parameters of an EDX, and in the absence of enhancement effects [1], we may consider that

$$N(Z) = R(Z) \cdot I \cdot \Delta t \cdot \frac{m(Z)}{A},$$

where N is the number of X-ray photons integrated in a characteristic peak of an element with atomic number Z , I is the current fixed in the X-ray tube, Δt is the live time of the spectrum, and m/A is the ratio of mass to the area in the sample. The production factor R may be reversely calculated using standards with known m/A ratios.

At the IFUSP PIXE system they fit, to experimental points, the theoretical equation expected for factor R versus Z [2]. In this work we adopted this idea for EDX, but making a polynomial fit to $R \times Z$, using matrix least square methodology (LS-M) [3]. Since LS-M uses all values in the fit to define the final uncertainties, we obtain R with a uncertainty better than individualized calibration do for each element. Else, the continuity of the functional fit, provides R values for elements we do not have standard targets, as show in the figure for X-ray K lines of thin Micromatter standards (excited with X-ray beam from a Rh tube at 50 kV, after an Al filter). Calibration drift with time was evaluated, and blind inter comparison with real aerosol samples analyzed by US-EPA showed good agreement.



[1] Tajani, A., Markowicz A.. EDXRF Analysis of Thin Samples, in Quantifying uncertainty in nuclear analytical measurements, IAEA-TECDOC-1401, ISBN 92-0-108404-8, p.45, 2004.

[2] Tabacniks, M. H.. Análise de Filmes Finos por PIXE e RBS, Instituto de Física-USP, Available at <http://www2.if.usp.br/~lamfi/pixe&rbs.pdf>, 2000, accessed on 30/03/2018.

[3] Helene, O.. Métodos dos Mínimos Quadrados, Editora Livraria da Física, 2006.