EXPERIMENTAL DETERMINATION OF ATOMIC PARAMETERS INVOLVING DECAYS TO THE K-SHELL

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ABSTRACT

K-shell X-ray emission induced by electron impact was studied for elements with atomic number between 12 and 30. The spectra were measured for incidence energies in the range 3-30 keV, with a scanning electron microscope equipped with a wavelength dispersive spectrometer.
Relative transition probabilities and natural linewidths were obtained for several transitions. In addition, X-ray production cross-section values were determined. This parameter, defined as the product of the fluorescence yield and the ionization cross-section, depends on the electron energy. For this reason, spectra produced with different excitation energies were investigated. The mentioned parameters were obtained by spectral fitting performed by means of the optimization routine implemented in the software POEMA[1]. This method consists in minimizing the differences between an experimental spectrum and an analytical function proposed to predict it, which takes into account characteristic peaks, bremsstrahlung and different detection artifacts. Thus, the quantity to be minimized is:

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where N is the number of channels in the spectral region of interest, P is the number of parameters fitted, $\tilde{I}_i$ and I_i are respectively the predicted and experimental intensities for the energy E_i corresponding to the channel i. Characteristic emission was taken into account by considering the so-called ZAF corrections, with a line profile given by a Voigt function, whereas an empirical model was used for the prediction of bremsstrahlung [2]. For the detection efficiency of the spectrometer, a model developed previously was implemented [3].
The results agree with experimental [4] and theoretical [5] data published by other authors, in most of the analyzed cases, considering the combined uncertainties.

Keywords: X-ray spectroscopy; relative transition probabilities; natural linewidths

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