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Standard Guide for Correction of Interelement Effects in X-Ray Spectrometric Analysis¹

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1. Scope

1.1 This guide is an introduction to mathematical procedures for correction of interelement (matrix) effects in quantitative X-ray spectrometric analysis.

1.1.1 The procedures described correct only for the interelement effect(s) arising from a homogeneous chemical composition of the specimen. Effects related to either particle size, or mineralogical or metallurgical phases in a specimen are not treated.

1.1.2 These procedures apply to both wavelength and energy-dispersive X-ray spectrometry where the specimen is considered to be infinitely thick, flat, and homogeneous with respect to the depth of penetration of the exciting X rays (1).²

1.2 This document is not intended to be a comprehensive treatment of the many different techniques employed to compensate for interelement effects. Consult References 2 through 4 for descriptions of other commonly used techniques such as standard addition, internal standardization, etc.

2. Referenced Documents

2.1 ASTM Standards:

E 135 Terminology Relating to Analytical Chemistry for Metals, Ores, and Related Materials³

3. Terminology

3.1 For definitions of terms used in this guide, refer to Terminology E 135.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *absorption edge*—the maximum wavelength (minimum X-ray photon energy) that can expel an electron from a given level in an atom of a given element.

3.2.2 *analyte*—an element in the specimen whose concentration is to be determined.

3.2.3 *characteristic radiation*—X radiation produced by an element in the specimen as a result of electron transitions between different atomic shells.

3.2.4 *coherent (Rayleigh) scatter*—the emission of energy

from a loosely bound electron which has undergone collision with an incident X-ray photon and has been caused to vibrate. The vibration is at the same frequency as the incident photon and the photon loses no energy. (See 3.2.7.)

3.2.5 *dead-time*—time interval during which the X-ray detection system, after having responded to an incident photon, cannot respond properly to a successive incident photon.

3.2.6 *fluorescence yield*—a ratio of the number of photons of all X-ray lines in a particular series divided by the number of shell vacancies originally produced.

3.2.7 *incoherent (Compton) scatter*—the emission of energy from a loosely bound electron which has undergone collision with an incident photon and the electron has recoiled under the impact, carrying away some of the energy of the photon.

3.2.8 *influence coefficient*—designated by α , a matrix correction factor for converting apparent concentrations to actual concentrations in a specimen. Other terms commonly used are alpha coefficient and interelement effect coefficient.

3.2.9 *mass absorption coefficient*—designated by μ , an atomic property of each element which expresses the X-ray absorption per unit mass per unit area, cm²/g.

3.2.10 *primary absorption*—absorption of incident X rays by the specimen. The extent of primary absorption depends on the composition of the specimen and the X-ray source spectral distribution.

3.2.11 *primary spectral distribution*—the output X-ray spectral distribution usually from an X-ray tube. The X-ray continuum is usually expressed in units of absolute intensity per unit wavelength per electron per unit solid angle.

3.2.12 *relative intensity*—the ratio of an analyte X-ray line intensity measured from the specimen to that of the pure analyte element. It is sometimes expressed relative to the analyte element in a multi-component standard reference material.

3.2.13 *secondary absorption*—the absorption of the characteristic X radiation produced in the specimen by all the elements in the specimen.

3.2.14 *secondary fluorescence (enhancement)*—the generation of X rays from the analyte caused by characteristic X rays from other elements in the sample whose energies are greater than the absorption edge of the analyte.

3.2.15 *weight fraction*—a concentration unit expressed as a ratio of the mass of analyte to the total mass.

3.2.16 *X-ray source*—an excitation source which produces

¹ This guide is under the jurisdiction of ASTM Committee E-1 on Analytical Chemistry for Metals, Ores, and Related Materials and is the direct responsibility of Subcommittee E01.20 on Fundamental Practices.

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² The boldface numbers in parentheses refer to the list of references at the end of this standard.

³ *Annual Book of ASTM Standards*, Vol 03.05.