Designation: E2426 – 10 (Reapproved 2019)

Standard Practice for Pulse Counting System Dead Time Determination by Measuring Isotopic Ratios with SIMS[1]

This standard is issued under the fixed designation E2426; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice provides the Secondary Ion Mass Spectrometry (SIMS) analyst with a method for determining the dead time of the pulse-counting detection systems on the instrument. This practice also allows the analyst to determine whether the apparent dead time is independent of count rate.

1.2 This practice is applicable to most types of mass spectrometers that have pulse-counting detectors.

1.3 This practice does not describe methods for precise or accurate isotopic ratio measurements.

1.4 This practice does not describe methods for the proper operation of pulse counting systems and detectors for mass spectrometry.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standard:*[2]

E673 Terminology Relating to Surface Analysis (Withdrawn 2012)[3]

2.2 *ISO Standard:*[4]

ISO 21270 Surface chemical analysis -- X-ray photoelectron and Auger electron spectrometers -- Linearity of intensity scale; and references 1, 2, 10, 13 and 14 therein.

3. Terminology

3.1 *Definitions:*

3.1.1 See Terminology E673 for definitions of terms used in SIMS.

3.1.2 See Terminology ISO 21270 for definitions of terms related to counting system measurements.

3.1.3 *isotopic ratio, n*—written as $^{m2}X/^{m1}X$, for an element X with isotopes $m1$ and $m2$, refers to the ratios of their atomic abundances. When it is a value measured in a mass spectrometer it refers to the ratio of the signal intensities for the two species.

3.1.3.1 *Discussion*—The notation $\Delta^{m2}X$ or $\delta^{m2}X$ refers to the fractional deviation of the measured isotopic ratio from the standard ratio or reference. In this practice, $\Delta^{m2}X$ will refer to the fractional deviation of the measured ratio, uncorrected for mass-fractionation (see 3.1.4) and $\delta^{m2}X$ will refer to the fractional deviation of the measured ratio that has been corrected for mass-fractionation. An example for magnesium (Mg) is:

$$\Delta^{25}\mathrm{Mg} = \frac{\left(^{25}\mathrm{Mg}/^{24}\mathrm{Mg}\right)_{Meas}}{\left(^{25}\mathrm{Mg}/^{24}\mathrm{Mg}\right)_{Ref}} - 1 \quad (1)$$

where:

$\left(^{25}\mathrm{Mg}/^{24}\mathrm{Mg}\right)_{Ref} = 0.12663$.[5]

3.1.4 *mass-fractionation, n*—sometimes called "mass-bias," refers to the total mass-dependent, intra-isotope variation in ion intensity observed in the measured isotopic ratios for a given element compared with the reference ratios. It can be expressed as the fractional deviation per unit mass.

3.1.4.1 *Discussion*—The mass of an isotope i of element X (^{mi}X) shall be represented by the notation m_i, where "i" is an integer.

[1] This practice is under the jurisdiction of ASTM Committee E42 on Surface Analysis and is the direct responsibility of Subcommittee E42.06 on SIMS.

Current edition approved Jan. 1, 2019. Published January 2019. Originally approved in 2005. Last previous edition approved in 2010 as E2426–10. DOI: 10.1520/E2426–10R19.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] The last approved version of this historical standard is referenced on www.astm.org.

[4] Available from International Organization for Standardization (ISO), ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, http://www.iso.org.

[5] Catanzaro, E. J., Murphy, T. J., Garner, E. L., and Shields, W. R., "Absolute Isotopic Abundance Ratios and Atomic Weight of Magnesium," *Journal of Research of the National Bureau of Standards*, Vol 70a, 1966, pp. 453–458.