



## Standard Practice for Elemental Identification by Auger Electron Spectroscopy<sup>1</sup>

This standard is issued under the fixed designation E 827; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### 1. Scope

1.1 This practice outlines the necessary steps for the identification of elements in a given Auger spectrum obtained using conventional electron spectrometers. Spectra displayed as either the electron energy distribution (direct spectrum) or the first derivative of the electron energy distribution are considered.

1.2 This practice applies to Auger spectra generated by electron or X-ray bombardment of the specimen surface; it does not apply to Auger spectra generated by other methods such as ion bombardment.

1.3 *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 and health practices and determine the applicability of regulatory limitations prior to use.*

### 2. Referenced Documents

#### 2.1 ASTM Standards:

- E 673 Terminology Relating to Surface Analysis<sup>2</sup>
- E 983 Guide for Minimizing Unwanted Electron Beam Effects In Auger Electron Spectroscopy<sup>2</sup>
- E 984 Guide for Identifying Chemical Effects and Matrix Effects in Auger Electron Spectroscopy<sup>2</sup>
- E 1523 Guide to Charge Control and Charge Referencing Techniques in X-Ray Photoelectron Spectroscopy<sup>2</sup>

### 3. Terminology

3.1 Terms used in Auger electron spectroscopy are defined in Terminology E 673.

### 4. Summary of Practice

4.1 The Auger spectrum is obtained with appropriate instrumental parameters from a low kinetic energy limit of approximately 30 eV to an upper kinetic energy limit of approximately 2000 eV or higher to include all the principal Auger electron energies of all elements (except H and He which do not have Auger transitions).

4.2 This practice assumes the existence of appropriate

reference spectra from pure element or stoichiometric compound standards, or both, with which an unknown spectrum can be compared.

4.3 An element in an Auger spectrum is considered positively identified if the peak shapes, the peak energies, and the relative signal strengths of peaks from the unknown coincide with those from a standard reference spectrum of the element or compound.

### 5. Significance and Use

5.1 Auger analysis is used to determine the elemental composition of the first few atomic layers, typically 0.5 to 2.0-nm thick, of a specimen surface. In conjunction with inert gas ion sputtering, it is used to determine the sputter depth profile to a depth of a few micrometres.

5.2 The specimen is normally a solid conductor, semiconductor, or insulator. For insulators, provisions may be required for control of charge accumulation at the surface (see Guide E 1523). Typical applications include the analysis of thin film deposits or segregated overlayers on metallic or alloy substrates. The specimen topography may vary from a smooth, polished specimen to a rough fracture surface.

5.3 Auger analysis of specimens with volatile species that evaporate in the ultra-high vacuum environment of the Auger chamber and substances which are susceptible to electron or X-ray beam damage, such as organic compounds, may require special techniques not covered herein. (See Guide E 983.)

### 6. Apparatus

6.1 *Electron Energy Analyzers*, such as retarding field analyzer, cylindrical mirror analyzer (single or double pass), or hemispherical analyzer.

6.2 *Standard Equipment*, typically including an electron gun or X-ray source for excitation, an electron multiplier for amplification of the Auger electron signal, and recording instrumentation.

6.2.1 A vacuum capability in the test chamber is required to allow analysis without contamination from the ambient atmosphere; depending on specimen surface conditions, analysis is performed in the pressure range from  $10^{-3}$  to  $10^{-8}$  Pa.

### 7. Procedure

7.1 Identify the peak having the largest signal strength in the spectrum and note its peak energy and characteristic shape.

<sup>1</sup> This practice is under the jurisdiction of ASTM Committee E-42 on Surface Analysis and is the direct responsibility of Subcommittee E42.03 on Auger Electron Spectroscopy and XPS.

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<sup>2</sup> *Annual Book of ASTM Standards*, Vol 03.06.