



# Standard Guide for Background Subtraction Techniques in Auger Electron and X-ray Photoelectron Spectroscopy<sup>1</sup>

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## 1. Scope

1.1 The purpose of this guide is to familiarize the analyst with the principal background subtraction techniques presently in use together with the nature of their application to data acquisition and manipulation.

1.2 This guide is intended to apply to background subtraction in electron, X-ray, and ion-excited Auger electron spectroscopy (AES), and X-ray photoelectron spectroscopy (XPS).

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 996 Practice for Reporting Data in Auger Electron Spectroscopy and X-ray Photoelectron Spectroscopy<sup>2</sup>

## 3. Terminology

3.1 *Definitions*—For definitions of terms used in this guide, refer to Terminology E 673.

## 4. Summary of Guide

### 4.1 Relevance to AES and XPS:

4.1.1 *AES*—The production of Auger electron excitation by bombardment of surfaces with electron beams is also accompanied by emission of secondary and backscattered electrons. These electrons range in energy from a maximum (near 10 eV for true secondaries), through the Auger spectrum, to a second maximum for backscattered electrons at the energy of the incident electron beam. An additional source of background is associated with Auger electrons, which are inelastically scattered while traveling through the specimen. Auger electron excitation may also occur by ion bombardment of surfaces.

4.1.2 *XPS*—The production of electrons from X-ray excita-

tion of surfaces may be grouped into two categories—photoemission of electrons and the production of Auger electrons from the decay of the resultant core hole states. The source of the background signal observed in the XPS spectrum includes a contribution from inelastic scattering processes, and for non-monochromatic X-ray sources, Bremsstrahlung radiation.

4.2 Various background subtraction techniques have been employed to diminish or remove the influence of these background electrons from the shape and intensity of Auger electron and photoelectron features. Relevance to a particular analytical technique (AES or XPS) will be indicated in the title of the procedure.

4.3 Implementation of any of the various background techniques that are described in this guide may depend on available instrumentation as well as the method of acquisition of the original signal. These subtraction methods fall into two general categories: (1) real-time background subtraction; and (2) post-acquisition background subtraction.

## 5. Significance and Use

5.1 Background subtraction techniques in AES were originally employed as a method of enhancement of weak Auger signals to distinguish them from the slowly varying background of secondary and backscattered electrons. Interest in obtaining useful information from the Auger peak line shape, concern for greater quantitative accuracy from Auger spectra, and improvements in data gathering techniques, have led to the development of various background subtraction techniques.

5.2 Similarly, the use of background subtraction techniques in XPS has evolved mainly from the interest in the determination of chemical states (binding energy values), greater quantitative accuracy from the XPS spectra, and improvements in data acquisition. Post-acquisition background subtraction is normally applied to XPS data.

5.3 The procedures outlined are popular in XPS and AES. General reviews of background subtraction techniques have been published (**1 and 2**).<sup>3</sup>

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

<sup>3</sup> The boldface numbers in parentheses refer to the references at the end of this standard.