INTERNATIONAL STANDARD

ISO 15471

Second edition
2016-09-01

Surface chemical analysis — Auger electron spectroscopy — Description of selected instrumental performance parameters

Analyse chimique des surfaces — Spectroscopie d'électrons Auger — Description de certains paramètres relatifs à la performance instrumentale

iTeh STANDARD PREVIEW
(standards.iteh.ai)

ISO 15471:2016
https://standards.iteh.ai/catalog/standards/sist/b62b313b-0dbc-4c98-83e0-639d27fa7b01/iso-15471-2016

Reference number
ISO 15471:2016(E)

© ISO 2016

iTeh STANDARD PREVIEW
(standards.iteh.ai)

ISO 15471:2016
https://standards.iteh.ai/catalog/standards/sist/b62b313b-0dbc-4c98-83e0-639d27fa7b01/iso-15471-2016

COPYRIGHT PROTECTED DOCUMENT

© ISO 2016, Published in Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

Contents

Page

Foreword ... **iv**

Introduction ... **v**

1 Scope ... **1**

2 Normative references ... **1**

3 Terms and definitions ... **1**

4 Symbols and abbreviated terms ... **1**

5 Description of selected instrumental performance parameters ... **1**

5.1 Method of analysis ... 1
5.2 Samples ... 2
5.3 System configuration ... 2
5.4 Electron gun cathode ... 2
5.4.1 Cathode type ... 2
5.4.2 Cathode lifetime ... 2
5.5 Lateral resolution and beam current ... 2
5.5.1 General ... 2
5.5.2 Method 1 ... 2
5.5.3 Method 2 ... 3
5.5.4 Method 3 ... 3
5.6 Spectrometer intensity performance and energy resolution ... 3
5.6.1 General ... 3
5.6.2 Method 1 ... 3
5.6.3 Method 2 ... 4
5.7 Spectrometer energy scale ... 4
5.8 Spectrometer intensity linearity ... 4
5.9 Spectrometer response function ... 4
5.10 Spectrometer parameters ... 4
5.10.1 Spectrometer aberration ... 4
5.10.2 Analytical area ... 4
5.11 Image drift ... 4
5.12 Vacuum environment ... 4

Bibliography ... **5**

iTeh STANDARD PREVIEW
(standards.iteh.ai)
ISO 15471:2016
https://standards.iteh.ai/catalog/standards/sist/b62b313b-0dbc-4c98-83e0-639d27fa7b01/iso-15471-2016

© ISO 2016 – All rights reserved

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

The committee responsible for this document is ISO/TC 201, *Surface chemical analysis*, Subcommittee SC 7, *Electron spectroscopies*.

ISO 15471:2016
https://standards.iteh.ai/catalog/standards/sist/...
...f30d27fa7b01/iso-15471-2016

This second edition cancels and replaces the first edition (ISO 15471:2004), of which it constitutes a minor revision with the following modifications:

— addition of a Bibliography;

— minor editorial changes to the text.

 © ISO 2016 – All rights reserved

Introduction

Auger electron spectrometers (AESs) and scanning Auger electron microscopes (SAMs) are produced by many manufacturers throughout the world. While the basic principles of the AES analytical method in each instrument are the same, the specific designs of the instruments and the way that performance specifications are provided differ widely. As a result, it is often difficult to compare the performance of instruments from one manufacturer with those from another. This International Standard provides a basic list of items devised to enable all Auger electron spectrometers to be described in a common manner. This International Standard is not intended to replace the manufacturer's specification, which may extend to 30 or more pages. It is intended that, where certain items are contained in that specification, there are agreed and defined meanings to those items.

iTeh STANDARD PREVIEW
(standards.iteh.ai)
ISO 15471:2016
https://standards.iteh.ai/catalog/standards/sist/b62b313b-0dbc-4c98-83e0-639d27fa7b01/iso-15471-2016

iTeh STANDARD PREVIEW
(standards.iteh.ai)
ISO 15471:2016
https://standards.iteh.ai/catalog/standards/sist/b62b313b-0dbc-4c98-83e0-639d27fa7b01/iso-15471-2016

Surface chemical analysis — Auger electron spectroscopy — Description of selected instrumental performance parameters

1 Scope

This International Standard specifies the requirements for the description of specific aspects of the performance of an Auger electron spectrometer.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 18115-1, *Surface chemical analysis — Vocabulary — Part 1: General terms and terms used in spectroscopy*

3 Terms and definitions

iTeh STANDARD PREVIEW
(standards.iteh.ai)

For the purposes of this document, the terms and definitions given in ISO 18115-1 apply.

4 Symbols and abbreviated terms

ISO 15471:2016
https://standards.iteh.ai/catalog/standards/sist/b62b313b-0dbc-4c98-83e0-639d27fa7b01/iso-15471-2016

AES Auger electron spectroscopy (also Auger electron spectrometer)

FWHM full width at half maximum

rms root mean square

SAM scanning Auger electron microscope (also scanning Auger electron microscopy)

SEM scanning electron microscope

FL Fermi level

VL vacuum level

NOTE Historically, the kinetic-energy scales of AES instruments have been referred to the VL while XPS or combined AES/XPS instruments have been referred to the FL. Conversion from FL to VL referencing is accomplished by subtracting the spectrometer work function from the electron kinetic energies; an approximate means for doing this, satisfactory for most practical AES and SAM applications, is to subtract 4,5 eV from kinetic energies referred to the FL.

5 Description of selected instrumental performance parameters

5.1 Method of analysis

A short description of the methods used to obtain information from the sample shall be given and the availability (as an option) of other analytical techniques in the system under consideration shall be stated.

© ISO 2016 – All rights reserved

5.2 Samples

The size and shape of samples that may be analysed with the instrument performing to specification shall be given. If the size or shape is restricted for particular modes of analysis, e.g. angle-resolved measurements, measurements for insulators, etc., this shall be specified.

5.3 System configuration

The designed geometric configuration of the significant analytical components of the system and their tolerances shall be described.

EXAMPLE Tolerances for angles are often given as ±1°.

5.4 Electron gun cathode

5.4.1 Cathode type

The cathode system shall be specified.

EXAMPLE Thermionic tungsten, lanthanum hexaboride (LaB_6), cold field emission tungsten (110), or Schottky.

5.4.2 Cathode lifetime

The expected lifetime of the cathode under the operating conditions specified in 5.5 shall be stated. The emission currents at chosen source potentials in 5.5 shall be stated. This would normally be a guarantee of lifetime operation but could, alternatively, be a mean historical lifetime. The type of lifetime shall be specified.

iTeh STANDARD PREVIEW
(standards.iteh.ai)
ISO 15471:2016
https://standards.iteh.ai/catalog/standards/sist/b62b313b-0dbc-4c98-83e0-639d27fa7b01/iso-15471-2016

5.5 Lateral resolution and beam current

5.5.1 General

Lateral resolutions shall be specified for the following:

a) SEM acquired at optimum operating conditions;

b) AES at specified conditions for each defined beam energy.

The measured value of the spatial resolution shall be obtained by one of the methods in 5.5.2, 5.5.3 or 5.5.4. Curves giving the typical lateral resolution as a function of beam current at 5 keV and/or 10 keV and any other appropriate beam energy shall be given.

NOTE If an instrument has a lateral resolution function that can be represented by a Gaussian function, then the FWHM of such a function corresponds to the distance over which the measured signal changes from 12 % to 88 % of its maximum value. In AES, the point spread function for the emitted Auger electrons is the Gaussian distribution of the beam superimposed on a backscattered halo. For this reason, it is convenient to define the lateral resolution as the distance corresponding to a 20 % to 80 % change in the Auger signal across the step edge, which is equivalent to 71,5 % of the Gaussian resolution function. Although there is no physical basis for this choice, it has been widely used. Lateral resolution methods are reported in ISO/TR 19319.

5.5.2 Method 1

A sample shall be analysed which has an isolated feature whose size is smaller than 30 % of the instrument's stated spatial resolution. The measured FWHM of a line trace for an Auger electron signal characteristic of that feature defines the spatial resolution. The distance for the feature signal to rise from 50 % of the maximum to 100 % and then fall again to 50 % defines the measured spatial resolution.

NOTE 1 If the width of the isolated feature is greater than 30 % of the spatial resolution, the measured spatial resolution will be greater than the true spatial resolution.

 © ISO 2016 – All rights reserved

NOTE 2 The use of a small sample allows easy confirmation of the system astigmatism.

5.5.3 Method 2

A sample shall be analysed which is comprised of two materials with their surfaces in the same plane and joined along a common straight edge. A line trace for an Auger electron intensity, characteristic of one of the two materials, measured at 90° to the edge, is used to define spatial resolution. The distance for the Auger electron intensity to change from 20 % to 80 % of the difference in the intensities in the plateau regions away from the edge defines the spatial resolution in the direction of the scan.

NOTE 1 If an instrument has a spatial resolution function that can be represented by a Gaussian function, then such an intensity distance distribution is equivalent to 71,5 % of the FWHM of the spatial resolution function of the instrument.

NOTE 2 Close to the limit of resolution, astigmatism can be observed and so the spatial resolution might need determination in more than one azimuth.

5.5.4 Method 3

A sample shall be analysed which is composed of a knife edge of one material, in the sample plane, over a hole with a depth more than five times its diameter. A line trace for an Auger electron intensity, characteristic of the knife edge material, measured at 90° to the edge, is used to define spatial resolution. The distance for the Auger electron intensity to change from 20 % to 80 % of the difference in the intensities in the plateau regions away from the edge defines the spatial resolution in the direction of the scan.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

NOTE 1 If an instrument has a spatial resolution function that can be represented by a Gaussian function, then such an intensity distance distribution is equivalent to 71,5 % of the FWHM of the spatial resolution function of the instrument.

NOTE 2 Close to the limit of resolution, astigmatism can be observed and so the spatial resolution might need determination in more than one azimuth.

ISO 15471:2016
https://standards.iteh.ai/catalog/standards/sist/b62b313b-0dbc-4c98-83e0-639d27fa7b01/iso-15471-2016

5.6 Spectrometer intensity performance and energy resolution

5.6.1 General

The spectrometer intensity performance is determined from the difference between the intensity (counting rate) of the Cu L_3VV peak at 918 eV and the background intensity (counting rate) at 950 eV (both measured in the direct mode). Performance shall be specified in pulse-counting systems as the difference in counting rates per nA of beam current or, alternatively, as the difference in counting rates at specified beam energy and beam current for (a) optimum energy resolution and (b) optimum sensitivity. If the spectrometer can be operated at different energy resolutions, the performance, the background intensity and the FWHM of the peak above background for each energy resolution shall be given at at least one beam energy. The beam current shall be given for each beam energy. The signal-to-noise ratio shall be defined as the ratio of the spectrometer intensity performance, obtained using data-acquisition time(s) of 1 s at 918 eV and 950 eV, to the noise obtained from 5.6.2 or 5.6.3. The method by which the noise is measured shall be stated.

5.6.2 Method 1

The noise is defined as the rms deviation of 121 separate measurements of the background intensity measured at regularly spaced energies between 970 eV and 994 eV using data-acquisition time(s) of 1 s for each measurement (channel) and approximately 0,2 eV channel intervals. The rms deviation is calculated from the deviations of the measured intensities from a least-squares fit of a straight line to the measured intensities.

© ISO 2016 – All rights reserved