
**Microbeam analysis — Analytical
electron microscopy — Method for the
determination of energy resolution
for electron energy loss spectrum
analysis**

*Analyse par microfaisceaux — Microscopie électronique analytique
— Méthode de détermination de la résolution énergétique pour
l'analyse spectrale de la perte d'énergie des électrons*



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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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Contents

Page

Foreword	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Symbols and abbreviated terms	3
5 Definition of the energy resolution	5
6 Reference materials and energy determination	5
6.1 General	5
6.2 Materials selection for energy scale calibration	5
6.3 Binding energy measurement of graphite in the XPS	6
7 Measurement procedure and energy resolution determination	6
7.1 General	6
7.2 Predetermination of binding energy	8
7.2.1 Obtain graphite and the other reference sample	8
7.2.2 Measure C1s of graphite by using the XPS	8
7.3 Setup of the S/TEM and the EELS, and sample setting	8
7.4 First energy step, δE_1 , calibration	8
7.4.1 EELS acquisition set-up	8
7.4.2 Determining the EELS first energy step, δE_1	8
7.4.3 Acquisition of carbon K-edge EEL spectrum	9
7.4.4 Calculate calibrated energy step δE_{1C}	9
7.5 Measurement of peak close to the zero-loss peak, E_{CZLP} , for the other reference sample using energy step δE_1	12
7.5.1 EEL spectrum acquisition of the second reference sample using energy step δE_1	12
7.5.2 Obtain the value for CH_2 between the zero-loss peak and the peak E_{CZLP}	13
7.5.3 Calculate the peak E_{CZLP} energy	13
7.6 Second energy step, δE_2 , calibration	14
7.6.1 Determining the EELS second energy step, δE_2	14
7.6.2 Acquire E_{CZLP} EEL spectrum	15
7.6.3 Obtain the value for CH_3 between the zero-loss peak and peak E_{CZLP}	15
7.6.4 Calculate calibrated energy step δE_{2C}	15
7.7 Determining the calibrated EEL spectrometer energy resolution, ΔE	15
7.7.1 Acquisition of a ZLP EEL spectrum	15
7.7.2 Obtain the value for CH_4 for the zero-loss peak	15
7.7.3 Calculate EEL spectrometer energy resolution, ΔE	15
7.8 Record items	16
8 Uncertainty for the measurement result of energy resolution	17
Annex A (informative) Example of measurement procedure for energy resolution determination	18
Annex B (informative) Correspondence between energy values of XPS C1s and EELS carbon K edge	26
Bibliography	28

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).

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For an explanation of the voluntary nature of standards, 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 www.iso.org/iso/foreword.html.

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A list of all parts in the ISO 23420 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

In order to understand the chemical composition, the atomic bonding and the electronic structure, electron energy loss analysis is often performed with the scanning transmission electron microscope or the transmission electron microscope (S/TEM) equipped with the electron energy loss (EEL) spectrometer.

In the analysis using EEL spectrometer system, the energy loss of incident electrons by the inelastic interaction via phonon and plasmon excitations, intra- and inter-band transitions and the inner shell ionization can be measured. The inner shell ionization is particularly useful and important as it gives the information on chemical composition of materials. For the precise analysis based on the energy loss peak decomposition and its energy shifts, it is vitally important to understand the energy resolution of the EEL spectrometer system. However, the determination method of the energy resolution is not standardized yet.

This document provides the procedures for energy step calibration and energy resolution determination useful for the electron energy loss spectrum analysis in the S/TEM equipped with the EEL spectrometer.

Microbeam analysis — Analytical electron microscopy — Method for the determination of energy resolution for electron energy loss spectrum analysis

1 Scope

This document specifies a determination procedure of energy resolution in the scanning transmission electron microscope or the transmission electron microscope equipped with the electron energy loss (EEL) spectrometer.

This document is applicable to both in-column type EEL spectrometer and post-column type EEL spectrometer. These EEL signal detecting systems are applicable to a parallel detecting system and a serial detecting system.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1

beam diameter

full width at half maximum (FWHM) of the electron beam intensity profile for the STEM observation

3.2

Boersch effect

energy spread of electron beam due to *Coulomb interaction* (3.5) between electrons in the beam

3.3

channel

range of one pixel of the detector in the *parallel detection* (3.17) EELS

3.4

collection angle

EELS entrance aperture diameter divided by a camera length and a *geometric factor* (3.13) for the STEM or the TEM diffraction mode, or EELS entrance aperture diameter divided by the distance from crossover of the lens in front of the EEL spectrometer to the EELS entrance aperture for imaging mode of the energy-filtering TEM

3.5

Coulomb interaction

repulsion of electrons by electric charge

3.6

detection plane

plane where energy dispersed electron focus