

ICS 71.040.50
CCS N 33



**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

GB/T 47185-2026

**Microbeam analysis - Analytical electron microscopy -
Calibration procedure of energy scale for elemental analysis by
electron energy loss spectroscopy**

微束分析 分析电子显微术 用于电子能量损失谱元素分析的能量标尺校准程序
(English Translation)

Issued on: February 27, 2026

Implemented on: September 1, 2026

Issued by: State Administration for Market Regulation

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Foreword

This document complies with the provisions of GB/T 1.1-2020 "Standardization Work Guidelines Part 1: Structure and Drafting Rules of Standardization Documents".

Drafting.

This document is modified to adopt ISO 24639:2022 "Microbeam analysis, analytical electron microscopy for elemental analysis of electron energy loss spectroscopy".

Energy scale calibration procedure.

This document has undergone the following structural adjustments compared to ISO 24639:2022.

---Move the note following Figure 7 of ISO 24639:2022 into the main text (see 5.3.4.1);

---Change ISO 24639:2022's 5.2.5 "Reference Material" to 5.2, and the original 5.2 to 5.3. Subsequent chapter numbers will be adjusted accordingly (see section 5).
chapter).

The technical differences between this document and ISO 24639:2022, and the reasons therefor, are as follows.

---The scope of this document has been changed (see Chapter 1) for ease of use;

---ISO 15932 (see Chapter 3) has been replaced with the normatively referenced GB/T 40300 to adapt to my country's technical requirements and add...

Operability;

---Added recommended values for relative thickness checks during electron energy loss spectrum acquisition (see 5.3.1) to enhance operability.

The following editorial changes have been made to this document.

---Added a note to "built-in energy loss spectrometer" in the terms and definitions (see 3.11);

---Some unused or one-time-used abbreviations have been removed;

---The abbreviation "CMOS" has been added (see Chapter 4);

---Added the definition "Electron Energy Loss Spectrum" to the abbreviation "EELS" (see Chapter 4);

---Explanations of the symbols in each formula have been added [see formulas (1), (2), (3), and (4)];

---Index numbers have been added after each figure (see Figures 4, 5, 6, and 7).

Please note that some content in this document may involve patents. The issuing organization of this document assumes no responsibility for identifying patents.

This document was proposed and is under the jurisdiction of the National Technical Committee on Standardization of Microbeam Analysis (SAC/TC38).

Introduction

Electron energy loss spectroscopy (EELS) can be used for elemental analysis with high spatial resolution. It can be applied using transmission electron microscopy (TEM) or scanning electron microscopy.

In a radio electron microscope (STEM), incident electrons penetrate an electron-transparent sample, such as a thinned sample, and are scattered by atoms in the sample; the spectrometer then...

Inelastic scattered electrons are analyzed to identify elements in the sample. This is achieved by comparing the peak energy and shape of the core loss edge with the peak energies of each element in a handbook.

By comparing scales and spectra, all elements from hydrogen to uranium can be identified. Within the energy range of 0 eV to 3000 eV, calibration should be performed according to this document.

The quasi-spectrometer enables the relative uncertainty of core loss edge energy measurement to be better than 3%, thus accurately identifying the core loss edge of each element and satisfying elemental analysis requirements.

The requirements for analysis.

Microbeam analysis electron microscopy Elemental analysis for electron energy loss spectroscopy Energy scale calibration procedure

1 Scope

This document describes the energy step and energy scale of electron energy loss spectra in transmission electron microscopy or scanning transmission electron microscopy.

The calibration procedure.

This document is applicable to the calibration of electronic energy loss spectra before elemental analysis, with a calibration energy range of 0 eV to 3000 eV.

This document is applicable to the analysis of electron energy loss spectra of transmitted electrons in thin samples, but not to the analysis of electron energy loss spectra of backscattered electrons in bulk samples.

Energy loss spectrum.

2 Normative references

The contents of the following documents, through normative references within the text, constitute essential provisions of this document. Dated citations are not included.

For references to documents, only the version corresponding to that date applies to this document; for undated references, the latest version (including all amendments) applies.

This document.

GB/T 40300 Microbeam Analysis - Terminology of Analytical Electron Microscopy (GB/T 40300-2021, ISO 15932-2013, MOD)

3 Terms and Definitions

The terms and definitions defined in GB/T 40300 and the following terms and definitions apply to this document.

Acceptance angle

Half of the electron beam cone angle defined by the entrance aperture of the electron energy loss spectrometer.

Note: See Figure 1.

channel

The range of a single pixel in a parallel detector.

collection angle

Half of the electron beam cone angle defined by the objective aperture.

Note: See Figure 1.

Convergence angle

Half the cone angle of the cone-shaped electron beam formed by the condenser lens system.

Note: See Figure 1.