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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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Foreword

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This document was prepared by Technical Committee ISO/TC 202, *Microbeam analysis*, Subcommittee SC 3, *Analytical electron microscopy*.

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.

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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