International Standard

ISO 20263

Microbeam analysis — Analytical electron microscopy — Method for the determination of interface position in the cross-sectional image of the layered materials

Analyse par microfaisceaux — Microscopie électronique analytique — Méthode de détermination de la position d'interface dans l'image de coupe transversale des matériaux en couches

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Foreword

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

This second edition cancels and replaces the first edition (ISO 20263:2017), which has been technically revised.

The main changes are as follows:

— introduction has been revised;

— terms and sources in Clause 3 have been revised;

— subclauses 5.2.2, 5.2.3, 6.1, 6.2.1, 6.7, 7.1, 7.2, A.4.1, B.2.3 and B.2.4 have been revised;

— figures have been revised.

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.

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Introduction

Multi-layered materials are widely used in the production of semiconductor devices, various kinds of sensors, coating films for optical element, new functional materials, etc. One of the factors used to determine the characteristics of multi-layered materials is the layer thickness, for evaluation of products and verification of the production process. In practice, measuring the total thickness and/or the thickness of each layer and checking the uniformity of thickness and/or flatness of the interface are often done using recorded images of the materials. Evaluations can be made from the cross-sectional TEM/STEM images by accurately determining the averaged interface position between two different layered materials.

In relation to the determination of the interface position in the HR atomic imaging, analysis by the multi-slice simulation (MSS) method can be applied for the target measurement, if the atomic structural models can be constructed. However, in real materials, there are a lot of cases when they cannot, such as:

— the interface between amorphous layers, or layers of amorphous substance and crystal;

— the interface recorded in low-resolution image in which the atomic columns cannot be identified:

  — for very thick single-layered material;

  — for thick multi-layered material.

This document gives the method to determine the averaged interface position using a differential processing of the accumulated intensity profile obtained from the ROI set in the cross-sectional TEM/STEM image of the multi-layered material. The thickness of the layer that can be applied ranges from a few nanometers to a few micrometers. Thus, this document is not intended for the determination of the simulated position of the layer interface analysed by the MSS method.

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Microbeam analysis — Analytical electron microscopy — Method for the determination of interface position in the cross-sectional image of the layered materials

1 Scope

This document specifies a procedure for the determination of the averaged interface position between two different layered materials recorded in the cross-sectional image of the multi-layered material. This document does not apply for determining the simulated interface of the multi-layered materials expected through the multi-slice simulation (MSS) method.

This document is applicable to the cross-sectional images of multi-layered materials recorded using a transmission electron microscope (TEM) or a scanning transmission electron microscope (STEM) and cross-sectional elemental mapping images using an energy dispersive X-ray spectrometer (EDS) or an electron energy loss spectrometer (EELS). This document is also applicable to digitized images recorded on an image sensor built into a digital camera, a digital memory set in the PC or an imaging plate, where the digitalized image is obtained by converting an analogue image recorded on photographic film using an image scanner.

2 Normative references

There are no normative references in this document.

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

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

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1.1
cross-sectional image
TEM/STEM image of the multi-layered materials along a plane perpendicular to the stacking direction

3.1.2
differential processing
calculation of the difference between the values of adjacent pixel data in the intensity profile

3.1.3
digital camera
device that detects the image using a chip-arrayed *image sensor* (3.1.12), such as a charge-coupled device (CCD) or complementary metal-oxide semiconductor (CMOS), which converts a visual image to an electric signal

[SOURCE: ISO 29301:2023, 3.7]

3.1.4
dot pitch
distance between adjacent pixels in pixel-based devices

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