



BSI Standards Publication

Microbeam analysis — Analytical electron microscopy — Method of determination for apparent growth direction of nanocrystals by transmission electron microscopy

National foreword

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A list of organizations represented on this committee can be obtained on request to its committee manager.

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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*.

This second edition cancels and replaces the first edition (ISO 19214:2017), which has been technically revised.

The main changes are as follows:

- the title, introduction and scope have been revised;
- Clause 3 has been revised;
- [Figures 1](#) and [2](#) have been replaced;
- [Annex D](#) has been added;
- editorial revisions have been made.

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

Nanocrystals are a main component in some advanced materials, especially nanomaterials, and also appear in traditional materials, such as needle-shaped precipitates in steels and alloys. Controlling the microstructure of these materials during fabrication is very important for quality control considerations. To control the microstructure and thereby improve the service properties of the relevant materials, the apparent growth direction, or the longest axis of the nanocrystals is one of the essential parameters. This direction of nanocrystals is generally determined by transmission electron microscopy (TEM).

Microbeam analysis — Analytical electron microscopy — Method of determination for apparent growth direction of nanocrystals by transmission electron microscopy

1 Scope

This document gives a method for determination of the apparent growth direction of nanocrystals by transmission electron microscopy. This method is applicable to all kinds of wire-like crystalline materials synthesized by various methods. This document can also guide in determining an axis direction of the second-phase particles in steels, alloys, or other materials. The applicable diameter or width of the crystals to be tested is in the range of tens to one hundred nanometres, depending on the accelerating voltage of the transmission electron microscope (TEM) and the material itself. Position, which is curved, twisted, and folded, to determine the apparent growth direction, should not be used.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes the requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 15932, *Microbeam analysis — Analytical electron microscopy — Vocabulary*

ISO 25498:2018, *Microbeam analysis — Analytical electron microscopy — Selected area electron diffraction analysis using a transmission electron microscope*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 15932 and the following 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

nanocrystal

discrete piece of crystalline material exhibiting a dimensional anisotropy with an axial elongation in one of the three nanocrystalline lattice direction in the nanoscale

3.2

apparent growth direction

crystalline direction which is parallel to the longest dimension of a single crystal

Note 1 to entry: Apparent growth direction does not involve mechanisms of the phase interface migration.

3.3

Miller notation

indexing system for diffraction patterns, which describes a crystal lattice by three axes coordinate