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Interested committees:

Title: Draft BS ISO 17297 Microbeam analysis — Focused ion beam application for TEM specimen preparation — Vocabulary.

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Introduction

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Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/ Figure/Table/Note	Type of comment	Comment (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	

DRAFT INTERNATIONAL STANDARD

ISO/DIS 17297

ISO/TC 202/SC 1

Secretariat: UNBS

Voting begins on:
2024-01-15

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2024-04-08

Microbeam analysis — Focused ion beam application for TEM specimen preparation — Vocabulary

ICS: 01.040.37

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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.

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The committee responsible for this document is ISO/TC 202.

Introduction

The electron microscope is a frequently used instrument to acquire not only high-resolution images but also great numbers of sample information such as structural and compositional information. There are two common types of electron microscopy available, scanning electron microscopy (SEM) and transmission electron microscopy (TEM).

In the case of TEM, transmitted electrons are required for the nanoscopic characterization of samples, and information on the inner structure of the sample is achieved, such as structure, morphology, and compositional information. Due to the necessity of transmitted electrons, TEM specimens must be prepared as thin as possible to allow electrons to be transmitted through, ~ a few tens of nanometres.

Typical capabilities of FIB instruments are the material removal by sputtering, the imaging by ion beam, and the deposition of materials at the nanoscale, which have led to many FIB applications, including the preparation of specimens for SEM and TEM. The site-specific and lift-out capabilities of FIB instruments significantly have enhanced not only the failure analysis but also the minimization of the specimen preparation period for materials science.

The dual-beam FIB-SEM platform provided 3D analysis and great improvements in the ability to prepare thin TEM specimens. A large variety of specimens can now be analysed by TEM, including semiconductors, metals, glass, polymers, composites, and biological specimens, via the benefits of FIB advancements. A lot more FIB applications will soon be available with further developments and advancements of FIB instruments including in-line automatic operation, multiple sample preparations, in-situ lift-out, new ion sources, and cryogenic techniques, which are still in their infancy. Nevertheless, the manufacturers/vendors of this field have technical characteristics to offer their unique features in terms of instrument technology.

1 Scope

A focused ion beam (FIB) is capable of site-specific TEM specimen preparation. The recent development of dual-beam, FIB coupled with SEM in a single system, has become a most powerful tool for TEM specimen preparation and microscopic applications. FIB technique has also become integrated into the semiconductor production line, in-line FIB systems combined with TEM, and available for failure analysis. Moreover, there are always exciting developments with novel instrumentations for many fields of materials research, such as new ion sources, in-situ test harnesses, novel detector configurations, and automation capabilities.

Due to various instrument parameters and plentiful technical knowledge for applications, entities to be newly involved in FIB are anticipated to increase, and there exists a risk of random development of technologies exploiting the essence of FIB. Hence, it is highly required to standardize certain aspects of the technique at an international level and establish an international standard serving as a basis for facilitating the easier use of the FIB technique by the users of TEM.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 10934:2020 Microscopes –Vocabulary for light microscopy

ISO 12749-4:2015 Nuclear energy, nuclear technologies, and radiological protection –Vocabulary—Part 4: Dosimetry for radiation processing

ISO 15609-3:2004 Specification and qualification of welding procedures for metallic materials – Welding procedure specification –Part 3: Electron beam welding

ISO 18115-1:2013 Surface chemical analysis – Vocabulary –Part 1: General terms and terms used in spectroscopy

ISO 19262:2015 Photography – Archiving Systems -- Vocabulary

ISO 80004-8:2020 Nanotechnologies –Vocabulary – Part8: Nanomanufacturing process

3 Terms and definitions used in the physical basis of the FIB system

3.1

altered layer

the surface region of material under ion bombardment where the chemical state or physical structure is modified by the effects of the ion bombardment

[SOURCE: ISO 18115-1]

3.2

amorphization

development of an amorphous phase on the surface of a crystalline specimen by displacement of atoms from their equilibrium positions, by the impingement of energetic ions generating a collision cascade within the sample

3.3

atomic mixing/intermixing

migration of sample atoms due to energy transfer with incident ions in the surface region

[SOURCE: ISO 18115-1, modified]

3.4

beam tail

ion beam typically has a Gaussian shape with the beam tails as the outer parts of the beam having less intensity compared to the beam centre; nevertheless, these (rounded) beam tails inhibit the milling of flat cross-section surfaces with sharp edges unless a protective layer on top of the specimens is used

3.5

charge neutralization

a process in which surface charging can be eliminated by bombarding the surface with electrons

3.6

charging potential

the electrical potential of the surface region of an insulating sample caused by irradiation

[SOURCE: ISO 18115-1]

3.7

chemical species

atom, molecule, ion, or functional group

[SOURCE: ISO 18115-1]

3.8

collision

an instance of the closest approach governed by interatomic potentials between the incident ion and the target atom

3.9

collision cascade

sequential energy transfer between atoms in a solid as a result of ion bombardment by energetic ions

[Source: ISO 18115-1, modified]

3.10

curtaining effect/waterfall effect

topographic irregularities on cross-section surfaces with the look of curtains or waterfalls, caused by materials inhomogeneities with different sputtering rates, specimen surfaces with strong topography and modulation of current density above the region of interest, which results in facets with striations and/or irregular non-flat cross-section surface.

3.11

diffusion range/projected range/range, transverse projected

path length for a single ion travel while moving in a sample, and is inversely related to its stopping power

3.12

elastic scattering

The interaction between a moving energetic ion and a sample without energy transfer between ions and sample atoms, results in the displacement of atoms and ion implantation which may induce amorphization and atomic mixing.

3.13

field-induced migration

effect occurring in insulators where internal electric fields created by ion bombardment cause the migration of sample atoms

[SOURCE: ISO 18115-1]

3.14

inelastic mean free path, ion

the average distance that an ion with a given energy travels through a sample before losing kinetic energy, a mathematical description of the probability of an inelastic scattering event

[SOURCE: ISO 21466, modified]