International Standard

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

Analyse par microfaisceaux — Application de faisceaux d'ions focalisés pour la préparation d'éprouvettes de MET — Vocabulaire

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Foreword

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Introduction

Electron microscopy is frequently used to acquire high-resolution images as well as a large amount of sample information, such as structural and compositional information. Two main types of electron microscopy are scanning electron microscopy (SEM) and transmission electron microscopy (TEM).

In the case of TEM, transmitted electrons are used for nanoscopic characterization of samples and information on the inner structure of the sample is obtained, such as the structure, morphology, and compositional information. Due to the necessity of electron transmission through the sample, TEM specimens must be prepared as thin as possible, in the range of a few tens of nanometres.

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

The dual-beam FIB-SEM platform allows for 3D analysis and significant 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. Further FIB applications are expected to be available with additional development and advancement 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.

Due to the numerous instrument parameters and large body of technical knowledge for application, FIB-based applications are expected to increase and there exists a risk of uncoordinated development of technologies. Hence, there is a need to standardize certain aspects of the technique at the international level and establish an international standard serving as a basis for facilitating the use of the FIB technique by TEM users.

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

1 Scope

This document defines the most commonly used terms for transmission electron microscopy (TEM) specimen preparation using focused ion beam (FIB).

2 Normative references

There are no normative references in this document.

3 Terms related to the physical basis of the FIB system

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
altered layer
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 18115-1:2023, 9.17]

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

[SOURCE: ISO 18115-1:2023, 9.9, modified — "incident particles" replaced with "incident ions" in the definition and Note 1 to entry removed.]

3.4
beam tail
low-intensity edge of an ion beam that typically has a Gaussian intensity distribution

Note 1 to entry: 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
process in which positive charge accumulation at the surface produced by an ion beam can be reduced or eliminated by flooding the surface with an electron beam

3.6
charging potential
positive charge accumulation at the surface produced by an ion beam

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