INTERNATIONAL STANDARD

ISO 13083

First edition
2015-08-15

Surface chemical analysis — Scanning probe microscopy — Standards on the definition and calibration of spatial resolution of electrical scanning probe microscopes (ESPMs) such as SSRM and SCM for 2D-dopant imaging and other purposes

Analyse chimique des surfaces - Microscopie à sonde à balayage - Normes sur la définition et l'étalonnage de la résolution spatiale des microscopes électriques à sonde à balayage (ESPMs) comme SSRM et SCM pour l'imagerie 2D-dopant et d'autres fins

Reference number
ISO 13083:2015(E)

© ISO 2015



COPYRIGHT PROTECTED DOCUMENT

© ISO 2015, Published in Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

Contents

Page

Foreword ... **iv**
Introduction ... **v**
1 Scope ... **1**
2 Normative references ... **1**
3 Terms and definitions ... **1**
4 Symbols and abbreviated terms ... **1**
5 General information ... **2**
5.1 Background information ... 2
5.2 Target ... 2
5.2.1 Scanning capacitance microscope ... 2
5.2.2 Scanning spreading resistance microscope ... 2
5.3 Measurement method for lateral resolution in SCM and SSRM ... 3
5.4 Key parameters in determining the lateral resolution ... 5
6 Measurement of lateral resolution of SCM with the sharp-edge method ... **5**
6.1 Background information ... 5
6.2 Selection of the sample ... 5
6.3 Setting the parameters before the operation of the instrument ... 6
6.4 Data collection ... 6
6.5 Data analysis ... 6
6.5.1 Obtaining the resolution ... 6
6.5.2 Random contributions to the resolution value ... 7
6.6 Recording of the parameters ... 7
7 Measurement of lateral resolution of SSRM with the sharp-edge method ... **8**
7.1 Background information ... 8
7.2 Selection of the sample ... 8
7.3 Setting the parameters before the operation of the instrument ... 8
7.4 Data collection ... 8
7.5 Data analysis ... 8
7.5.1 Obtaining the resolution ... 8
7.5.2 Random contributions to the resolution value ... 9
7.6 Recording of the parameters ... 9
Annex A (informative) **An example of the measurement of SCM resolution** ... **10**
Annex B (informative) **An example of the measurement of SSRM resolution** ... **12**
Bibliography ... **14**

© ISO 2015 – All rights reserved

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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 201, *Surface chemical analysis,* Subcommittee SC 9, *Scanning probe microscopy*.

© ISO 2015 – All rights reserved

Introduction

Electrical scanning probe microscopy (ESPM) is a branch of scanning probe microscopy (SPM) with the capability of electrical imaging at nanometre spatial resolution. ESPM includes electrostatic force microscopy (EFM), scanning capacitance microscopy (SCM), scanning spreading resistance microscopy (SSRM), etc. Because ESPM can observe electrical or electronic properties with molecule-scale resolution, it is applied to many fields such as semiconductors, displays, etc. However, there has been no standard measurement method for the spatial resolution.

In this International Standard, standardized procedures to determine the spatial (lateral) resolution of SSRM and SCM, which are widely used to image the distribution of carrier and other electrical properties in semiconductor devices, are provided with the use of suitable reference materials. This International Standard uses the sharp-edge method to measure the lateral resolution of ESPM in a similar manner to that already used in measuring the resolution in micro-beam spectroscopy and in depth-profiling measurements with Auger electron spectroscopy and X-ray photoelectron spectroscopy (refer to ISO 18516).

© ISO 2015 – All rights reserved

Surface chemical analysis — Scanning probe microscopy — Standards on the definition and calibration of spatial resolution of electrical scanning probe microscopes (ESPMs) such as SSRM and SCM for 2D-dopant imaging and other purposes

1 Scope

This International Standard describes a method for measuring the spatial (lateral) resolution of scanning capacitance microscopes (SCMs) or scanning spreading resistance microscopes (SSRMs), which are widely used in imaging the distribution of carriers and other electrical properties in semiconductor devices. The method involves the use of a sharp-edged artefact.

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 18115-2, *Surface chemical analysis – Vocabulary – Part 2: Terms used in scanning-probe microscopy*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 18115-2 and the following apply.

3.1
electrical scanning probe microscopy
ESPM
SPM mode in which a conductive tip is used to measure electrical properties such as capacitance, resistance, electrical field, etc.

3.2
contact mode
mode of scanning the probe tip over the sample surface, adjusting the relative heights of the probe and sample, in which there is always a repulsive force between the probe and the sample

Note 1 to entry: This mode can be, for example, either the constant-height or constant-force mode.

[SOURCE: ISO 18115-2:2013, 6.35]

4 Symbols and abbreviated terms

AC	alternating current
DC	direct current
ESPM	electrical scanning probe microscopy
SPM	scanning probe microscopy
AFM	atomic force microscopy

© ISO 2015 – All rights reserved