
**Surface chemical analysis —
Secondary-ion mass spectrometry —
Method for depth calibration for silicon
using multiple delta-layer reference
materials**

*Analyse chimique des surfaces — Spectrométrie de masse des ions
secondaires — Méthode pour l'étalonnage de la profondeur pour le
silicium à l'aide de matériaux de référence à couches delta multiples*



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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 23812 was prepared by Technical Committee ISO/TC 201, *Surface chemical analysis*, Subcommittee SC 6, *Secondary ion mass spectrometry*.

Introduction

Secondary-ion mass spectrometry (SIMS) is a powerful method for the measurement of depth profiles of dopants in silicon. However, in the near-surface region (< 50 nm), the transient behaviours of the secondary-ion yields and the sputtering rate significantly affect the profile shape ^[1], thus it is difficult to obtain real profiles. This is caused by the accumulation of implanted primary-ion species, oxygen or caesium, which are essential for enhancing the secondary-ion yields. At the original surface, sputtering of the specimen material occurs with a low concentration of primary-ion species, but, with the progress of sputtering, primary-ion species are incorporated on the surface and sputtered together with the specimen atoms, causing a sputtering-rate change. As a result of the sputtering-rate change in this non-equilibrium zone, a significant profile shift occurs in shallow SIMS depth profiles when a uniform sputtering rate is assumed for depth calibration.

To calibrate the depth scale in such a shallow region, it is essential to evaluate the extent of the above profile shift accurately. In this International Standard, multiple delta-layers are used as a reference material for depth scale calibration in the near-surface region but beyond the non-equilibrium zone, and the procedures for depth scale calibration are described.

This International Standard differs from ISO 20341 in its scope. ISO 20341 specifies procedures for estimating depth resolution parameters in SIMS depth profiling using multiple delta-layer reference materials, whereas this International Standard specifies a procedure for calibrating the depth scale in a shallow region.

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Surface chemical analysis — Secondary-ion mass spectrometry — Method for depth calibration for silicon using multiple delta-layer reference materials

1 Scope

1.1 This International Standard specifies a procedure for calibrating the depth scale in a shallow region, less than 50 nm deep, in SIMS depth profiling of silicon, using multiple delta-layer reference materials.

1.2 This International Standard is not applicable to the surface-transient region where the sputtering rate is not in the steady state.

1.3 This International Standard is applicable to single-crystalline silicon, polycrystalline silicon and amorphous silicon.

2 Normative references

The following referenced documents are indispensable for the application 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 18115, *Surface chemical analysis — Vocabulary*

ISO 20341, *Surface chemical analysis — Secondary-ion mass spectrometry — Method for estimating depth resolution parameters with multiple delta-layer reference materials*

3 Terms and definitions

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

4 Symbols and abbreviated terms

a	intercept of regression line
b	slope of regression line
c	extra factor of regression line slope
$I(z)$	ion intensity at depth z
k	correction factor for the primary-ion current density
l	number of delta-layers used for regression analysis
L_s	shift distance
$L_s(p)$	shift distance dependent on the definition of delta-layer peak position (see 7.2.1)