

SEMI M67-1106 (Preliminary)

PRACTICE FOR DETERMINING WAFER NEAR-EDGE GEOMETRY FROM A MEASURED THICKNESS DATA ARRAY USING THE ESFQR AND ESFQD METRICS

This standard was technically approved by the global Silicon Wafer Committee. This edition was approved for publication by the global Audits and Reviews Subcommittee on August 24, 2006. It was available at www.semi.org in October 2006 and on CD-ROM in November 2006.

1 Purpose

- 1.1 Wafer near-edge geometry can significantly affect the yield of semiconductor device processing.
- 1.2 Knowledge of near-edge geometrical properties can help the producer and consumer determine if the dimensional characteristics of a wafer satisfy given geometrical requirements.
- 1.3 This practice is suitable for quantifying the flatness aspects of near-edge geometry of wafers used in semiconductor device processing.
- 1.4 The ESFQR or ESFQD metric may be more suitable for quantifying the flatness aspects of near-edge geometry than traditional metrics such as SFQR or SFQD. ESFQR and ESFQD quantify near-edge geometry fully and consistently at all angular positions on the wafer edge except at locations intentionally excluded. SFQR and SFQD, on the other hand treat different angular positions differently and do not typically provide full coverage of the wafer edge.

NOTE 1: Acronyms beginning with E are the same as those in Appendix 1 of SEMI M1 except that they relate to the near-edge region and have specified site dimensions.

- 1.5 Consideration should be given to the use of near-edge geometry metrics as a process control tool rather than a material exchange specification.
- 1.6 There are other metrics for near-edge geometry, some of which quantify other aspects such as edge roll-off (ERO).

NOTE 2: ERO is frequently employed as a more general term for describing near-edge geometry, but as of the approval date of this standard there are no standardized conditions or test procedures for it. As such a general term, ERO is included in the keywords for this standard, even though it is outside the scope of the standard.

- 1.7 Other metrics analogous to flatness metrics, for example ESBIR, can be calculated, but these are outside the scope of this practice.

2 Scope

- 2.1 This practice covers calculation of the near-edge geometry metrics ESFQR and ESFQD.¹
- 2.2 The metrics calculated by this practice are based on a thickness data array. This array represents the front surface of the wafer when the back surface of the wafer is ideally flat, as when pulled down onto an ideally clean flat chuck.
- 2.3 This practice is suitable for polished, epitaxial, SOI, or other layer condition.
- 2.4 The practice is applicable to notched 200 and 300 mm diameter wafers having dimensions in accordance with wafer categories 1.9.2 and 1.15 of SEMI M1.
- 2.5 This practice does not cover acquisition of the thickness data array. However, it gives the required characteristics of the thickness data array.

NOTICE: This standard does not purport to address safety issues, if any, associated with its use. It is the responsibility of the users of this standard to establish appropriate safety and health practices and determine the applicability of regulatory or other limitations prior to use.

¹ The calculation of these metrics is the subject of a patent application published as US. Pub. No. US-2006-0004542 by ADE Corporation, 80 Wilson Way, Westwood, MA 02090-1806. ADE has informed SEMI that, per SEMI regulations, it will license any patent resulting from this application on reasonable and customary terms.

3 Limitations

3.1 Deficiencies of data such as inadequate spatial resolution, mispositioning, noise, etc. in the thickness data array used to calculate the metrics may lead to erroneous results.

3.2 The calculations of this practice do not remove wafer shape and therefore are not applicable to data obtained from unclamped wafer single-surface data.

3.3 The reference plane used in the calculation is dependent on both the radial length and sector span.

4 Referenced Standards and Documents

4.1 SEMI Standards

SEMI M1 — Specifications for Polished Monocrystalline Silicon Wafers

SEMI M20 — Practice for Establishing a Wafer Coordinate System

SEMI M59 — Terminology for Silicon Technology

SEMI MF1530 — Test Method for Measuring Flatness, Thickness, and Total Thickness Variation on Silicon Wafers by Automated Non-Contact Scanning

NOTICE: Unless otherwise indicated, all documents cited shall be the latest published versions.

5 Terminology

5.1 Many terms used in silicon wafer technology are defined in SEMI M59.

5.2 Other Definitions

5.2.1 *edge roll-off (ERO)* — surface deviations of a large-diameter silicon wafer near the edge, but excluding effects due to wafer edge profiling and surface roughness.

5.2.2 *near-edge geometry* — the topography of a surface of a large diameter silicon wafer in the outer region of the fixed quality area (FQA).

6 Summary of Practice

6.1 Sectors for metric calculation are defined by FQA radius, sector radial length and sector angular extent. Required exclusions are defined.

6.2 A thickness data array in an annulus of defined radial length and location is acquired.

6.3 A reference plane is constructed in each sector.

6.4 ESFQR for each sector is calculated as the range of the reference plane deviation within the sector.

6.5 ESFQD for each sector is calculated as the reference plane deviation having the largest absolute value within the sector while retaining the sign.

6.6 Recipe parameters are reported.

6.7 ESFQR and ESFQD are reported for each sector. Statistical quantities for these parameters are also calculated and reported for each wafer.

7 Apparatus

7.1 *Measuring Equipment* — Suitable for acquiring the thickness data array and transferring it to the calculation software.

NOTE 3: A test method for acquiring a suitable thickness data array is being considered for development by the Silicon Wafer Committee.

7.1.1 The equipment shall perform all necessary calculations and corrections needed to produce the thickness data array internally and automatically, including instrument-dependent exclusion areas. The equipment shall be equipped with a means of detecting and either deleting or identifying invalid data (over-range signal).

7.1.2 Thickness resolution shall be 10 nm or smaller.

7.1.3 Thickness array data point spacing shall be 0.5 mm or less in two orthogonal directions in the plane of the wafer. The thickness data array coordinate system is per SEMI M20.

7.1.4 The spatial resolution of the thickness data array shall be specified.

7.1.5 The thickness data array must cover an annulus including the entire FQA boundary (except in exclusion areas) and the inner boundary of the sector annulus (see ¶ 9.1.2).