

SEMI MF534-0707 (Withdrawn 0115) TEST METHOD FOR BOW OF SILICON WAFERS

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NOTICE: This Document was balloted and approved for withdrawal in 2015.

NOTICE: The section symbol (§) is used to reference a numbered section, paragraph, or header and all subordinate paragraphs, headers, and embedded material (i.e., EXCEPTIONs, lists) therein. The paragraph symbol (¶) is used to reference a particular numbered paragraph and embedded material therein. When duplicated (i.e., §§ and ¶¶) the symbols are used to reference more than one section or paragraph, respectively.

1 Purpose

1.1 The flatness of a wafer surface must be controlled to suit the requirements of fixtures and equipment used in microelectronic processing. Bow is a contributor to the lack of surface flatness of a wafer. Although moderate amounts of bow can be removed during processing by vacuum chucking or by clamping the wafer, excessive amounts of bow cannot be removed in this fashion.

1.2 In particular, photolithographic processes are adversely affected if the front surface of the wafer is not flat.

1.3 This Test Method is intended for use for materials acceptance and process control purposes. Estimates of the magnitude of bow on a representative sample from a given lot of wafers aid in determining whether or not wafers from that lot are acceptable for the intended processing steps. Measurements made on wafers following a particular processing step aids in determining the amount of bow introduced by that processing step.

1.4 If the median surface of a free, unclamped wafer has a curvature that is everywhere the same, bow is a measure of its concave or convex deformation, independent of any thickness variation that may be present. Positive values of bow denote a convex (mounded) median surface when the wafer is positioned with its front surface up. Conversely, negative values of bow denote a concave (dished) median surface when the wafer is positioned with its front surface up. Although bow may be caused by unequal stresses on the two exposed surfaces of the wafer, it cannot be determined from measurements on a single exposed surface.

1.5 Bow is only one of several geometrical properties that affect surface flatness. Procedures for determining other such properties are given in SEMI MF533, SEMI MF657, SEMI MF1390, SEMI MF1451, and SEMI MF1530.

1.6 When this Test Method was developed in the 1970s, noncontact bow and warp gages employing manual positioning, which are the basis of this test method, were in routine use. More recently, faster, automated instruments have replaced these manual gages for most common uses in the semiconductor industry. In these automatic systems, microprocessors or microcomputers are used to control wafer positioning, operate the instrument and to analyze the data (see SEMI MF1390).

1.7 Despite the fact that this test method is not commonly used in its present form, it embodies all the basic elements of wafer bow measurement and a simple analysis of data. Thus, it provides useful guidance in the fundamentals and application of differential noncontact wafer bow measurements.

2 Scope

2.1 This Test Method covers determination of the average amount of bow of nominally circular silicon wafers, polished or unpolished, in the free (nonclamped) condition.

2.2 This Test Method is intended primarily for use with wafers that meet the dimension and tolerance requirements of SEMI M1.

2.3 This Test Method can also be applied to circular wafers of other semiconducting materials, such as gallium arsenide, or electronic substrate materials, such as sapphire, that have a diameter of 25 mm or greater, a thickness of 0.18 mm or greater, and a ratio of diameter to thickness up to 250. Wafers to be tested may have one or more fiducial

flats provided they are located in such a way that the wafer can be centered on the support pedestals (see ¶ 7.1.2) without falling off.

2.4 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

NOTICE: SEMI Standards and Safety Guidelines do not purport to address all safety issues associated with their use. It is the responsibility of the users of the Documents to establish appropriate safety and health practices, and determine the applicability of regulatory or other limitations prior to use.

3 Limitations

3.1 Since the determination of bow by this Test Method is based on measurements at a limited number of discrete points, geometrical variations in other parts of the wafer may not be detected.

3.2 Localized thickness deviations in the areas of pedestal contact or of the wafer center may result in erroneous readings. Such localized thickness deviations may be caused by surface defects such as chips, contaminants, mounds, pits, saw steps, waves, and so forth.

3.3 If the curvature of the median surface is not everywhere in the same direction, the deformation of the median surface is not characterized by bow, and the quantity measured by this technique may or may not provide an indication of the deviation of the median surface from a plane (refer to SEMI MF657 or SEMI MF1390).

4 Referenced Standards and Documents

4.1 SEMI Standards and Safety Guidelines

SEMI M1 — Specification for Polished Single Crystal Silicon Wafers

SEMI M59 — Terminology for Silicon Technology

SEMI MF533 — Test Method for Thickness and Thickness Variation of Silicon Wafers

SEMI MF657 — Test Method for Measuring Warp and Total Thickness Variation on Silicon Wafers by Noncontact Scanning

SEMI MF1390 — Test Method for Measuring Warp on Silicon Wafers by Automated Noncontact Scanning

SEMI MF1451 — Test Method for Measuring Sori on Silicon Wafers by Automated Noncontact Scanning

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

4.2 ISO Standards¹

ISO 14644-1 — Cleanrooms and Associated Controlled Environments – Part 1: Classification of Airborne Particulates

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

5 Terminology

5.1 Terms relating to silicon and other semiconductor technology are defined in SEMI M59.

6 Summary of Test Method

6.1 The wafer is supported, front surface upward, on three points equally spaced on the circumference of a circle whose diameter is slightly smaller than the wafer diameter.

6.2 The distance between the center point of the front surface and the reference plane formed by the three supporting points is measured with a lightly loaded indicator.

6.3 The wafer is turned over and the measurement is repeated with the wafer supported at three points directly opposite (through the thickness of the wafer) from the original three points.

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