

SEMI HB14-0223

TEST METHOD FOR DETERMINING GEOMETRICAL PARAMETERS OF PATTERNS ON PATTERNED SAPPHIRE SUBSTRATE

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1 Purpose

- 1.1 Because there are various requirements and measurement methods for patterned sapphire substrate (PSS) in the LED industry, a standardized measurement method of PSS needs to be established so that customers and PSS suppliers can work together smoothly.
- 1.2 It is necessary to establish a standardized measurement method of PSS so that PSS suppliers will be able to provide clear and consistent product information to customers.

2 Scope

- 2.1 Provides a measurement method for the size, height, pitch, sidewall angle, of selected point on patterned sapphire substrates.
- 2.2 Provides a measurement method for the reflectivity of entire surface on patterned sapphire substrate.
- 2.3 Geometric PSS pattern measurements are limited to individual pattern and pattern array characteristic condition measurements.

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 None.

4 Referenced Standards and Documents

4.1 SEMI Standards and Safety Guidelines

SEMI HB1 — Specification for Sapphire Wafers Intended for Use for Manufacturing High Brightness-Light Emitting Diode Devices

4.2 ISO® Standards¹

ISO 9001:2015 — Quality Management Systems – Requirements

ISO/IEC 17025:2017 — General Requirements for the Competence of Testing and Calibration Laboratories

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

5 Terminology

5.1 Abbreviations and Acronyms

- 5.1.1 *AFM* — atomic force microscope
- 5.1.2 *EBR* — edge bead removal

¹ International Organization for Standardization, ISO Central Secretariat, Chemin de Blandonnet 8, CP 401-1214 Vernier, Geneva, Switzerland; Telephone: +41.22.749.01.11, Fax: +41.22.733.34.30, <http://www.iso.org>. ISO trademark is owned by International Organization for Standardization.

5.1.3 *PSS* — patterned sapphire substrate

5.1.4 *SEM* — scanning electron microscope

5.2 Definitions

5.2.1 *edge bead removal (EBR)* — wafer edge photoresist removal process.

5.2.2 *pattern* — geometric structures aligned array or individually on the surface of sapphire substrate.

5.2.3 *patterned sapphire substrate (PSS)* — sapphire substrate with periodically array patterns on the surface.

5.2.4 *reflectivity* — refers to the ratio of the power of reflected light to the power of incident. and the figures are expressed in percentages.

5.2.5 *R value* — maximum projected deviation of meridian from the cone slant edge.

6 Summary of Test Method

6.1 As shown in Figure 1 and Figure 2, two methods are used to examine PSS patterns. Figure 1 shows the Microscope and Wafer Mapping inspection mode. Figure 2 shows the AFM and SEM inspection methods.

6.2 The A scan mode is a method in which the inspection camera performs along a designated line. B scan mode is a method in which a front inspection camera scans from top surface to bottom surface. C scan mode is front inspection camera scans the whole front side of the wafer at one time.

6.3 The point measurement method is the method to measure the geometric PSS pattern for each point, and it should be performed differently for each wafer size as shown in Figure 2.

6.3.1 Scanning Measurement

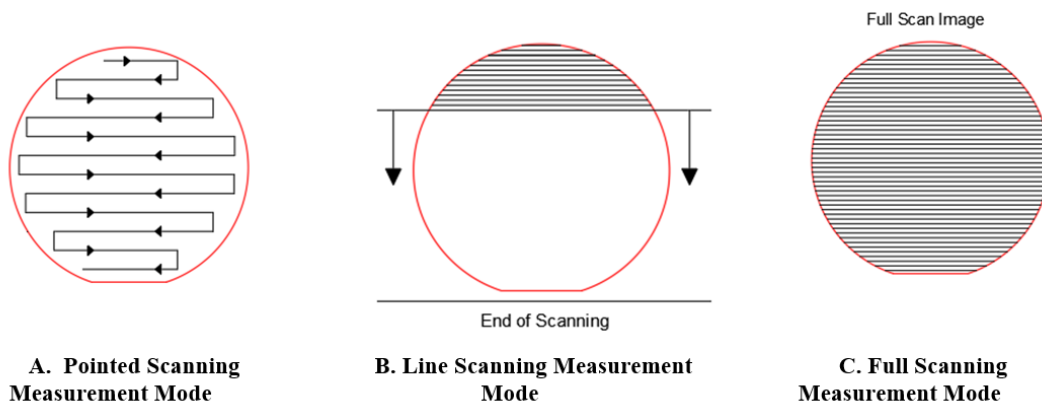


Figure 1
Types of Scanning Measurement Mode

6.3.2 Point Measurement

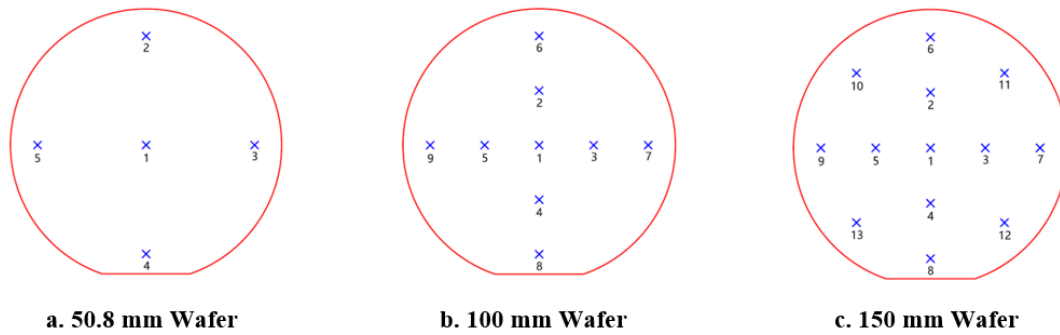


Figure 2
Types of Point Measurement Methods

6.4 Default Measurement Method

6.4.1 It measures using AFM, SEM, and Wafer mapping inspection equipment. Each wafer's basic size information is based on the Table 1.

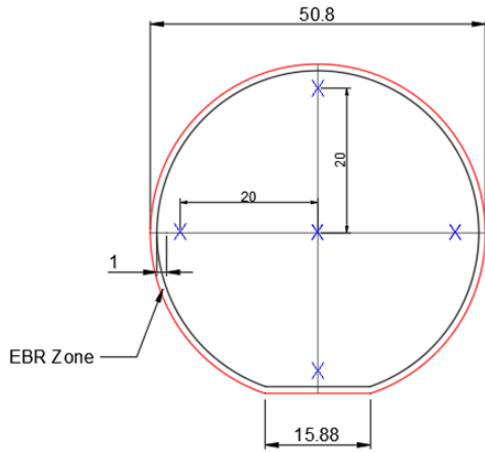
6.4.2 PSS wafer types can be divided into EBR products and none EBR products.

Table 1 Wafer Basic Measurement Information

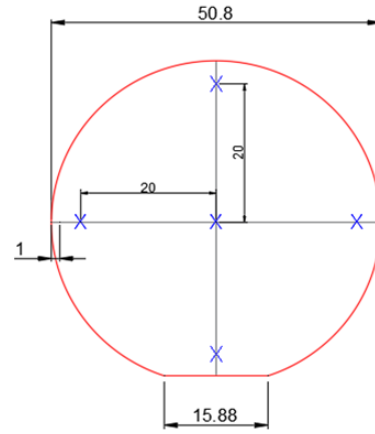
No	Parameters of Basic Measurement Point				
1	Diameter	50.8 mm ±0.50 mm	100 mm ±0.50 mm	150 mm ± 0.20 mm	
2	Flat Length	15.88 mm ±1.65 mm	32.5 mm ±2.5 mm	47.5 ± 2.5 mm or 25 ± 2.5 mm	Not applicable
3	Notch Depth	Not applicable	Not applicable	Not applicable	1.0 mm +0.25 mm – 0.00 mm
4	Notch Angle	Not applicable	Not applicable	Not applicable	90° + 5° – 1°
5	Quantity of Measurement point	5 points	9 points	13 points	
6	Pitch of Measurement point	20 mm ±2.0 mm	20 mm ±2.0 mm	30 mm ± 2.0 mm (9 points) 40 mm ± 2.0 mm (4 points)	
7	EBR - Edge exclusion	1 mm ±0.50 mm	1 mm ±0.50 mm	1 mm ± 0.50 mm	
8	None EBR - Edge exclusion	1 mm ±0.50 mm	1 mm ±0.50 mm	2 mm ± 0.50 mm	

6.4.3 Show detailed measurement locations of 50.8 mm, 100 mm, 150 mm PSS wafers. Products are classified as EBR and None EBR products. Figures 3, 4, and 5 show 50.8 mm, 100 mm, and 150 mm wafers respectively.

6.4.4 All points are measured within the wafer are based on 20 mm. 150 mm are based on 30 mm, and 4 points are based on 40 mm.

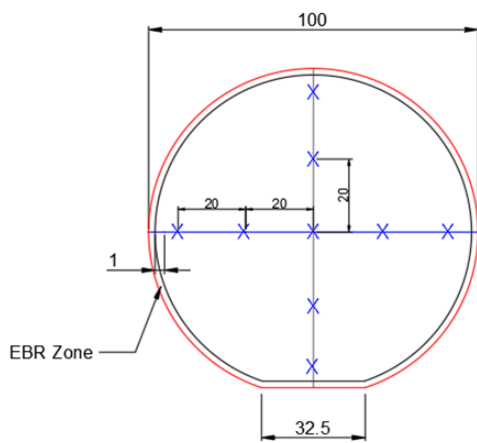


a. EBR

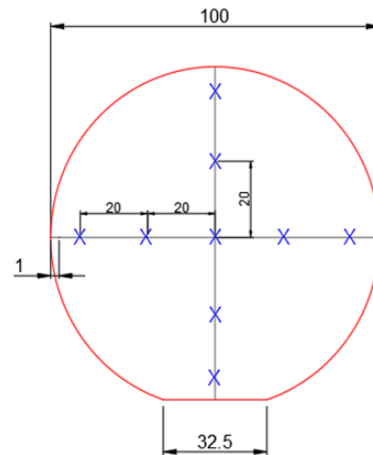


b. None EBR

Figure 3
50.8 mm Wafer Basic Measurement Point



a. EBR



b. None EBR

Figure 4
100 mm Wafer Basic Measurement Point