SEMI M38-0312 (Reapproved 0718)
SPECIFICATION FOR POLISHED RECLAIMED SILICON WAFERS

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1 Purpose

1.1 Silicon wafers are often subjected to reclaim processes in order to improve manufacturing efficiency in device production. A reclaimed wafer is one that has been re-conditioned for subsequent utilization.

1.2 This Specification covers requirements for reclaimed silicon wafers to be used for testing and process monitoring in semiconductor manufacturing.

1.3 In some instances for 300 mm wafers with supplier marked back surfaces, it is necessary to re-inscribe the mark after one or more reclaim cycles. Consequently, this Specification also includes an Appendix that covers the re-inscription of such wafers.

NOTE 1: Issues related to the re-inscription of such 300 mm wafers are discussed in Related Information 1.

2 Scope

2.1 This Specification divides reclaimed wafers into four application categories: Mechanical, Furnace, Particle, and Lithography and provides tables of the specification requirements for each category. Thus, a prospective purchaser of reclaimed silicon wafers needs to know which application matches his or her requirements.

2.2 Only requirements for some attributes are specified in Tables 1 and 2. Other requirements are indicated to be 'customer specified' which means that the customer may specify a requirement for that particular attribute, 'as-supplied' which means that the attribute has whatever value was supplied in the wafer delivered (or used) for reclaim, and 'unspecified' which means that the attribute is not specified and for which the wafer does not need to be tested.

2.3 In addition to the general categories listed in ¶ 2.1, this Specification provides requirements for reclaimed wafers intended for use in advanced device production, including devices in the 180 and 130 nm technology generations in the third table.

2.4 This Specification is directed specifically to silicon wafers with one or both polished surfaces. If the wafers have epitaxial deposits, the attributes of the epitaxial layer are not included the specification requirements.

2.5 This Specification covers reclaim wafers that are either customer-supplied or third party-sourced. The user should exercise caution when sourcing materials with unknown thermal histories, unknown bulk contamination, or unknown deposits, such as gold (Au) films.

2.6 For applications placing higher demands on silicon wafers such as particle counting, measuring pattern resolution in a photolithography process, or surface ion contamination monitoring, the customer may want to reference SEMI M1, SEMI M8, or SEMI M24.

2.7 For reference purposes, U.S. customary units shall be used for wafers of 2- and 3-inch nominal diameter and System International (SI), commonly called metric, units for 100 mm and larger diameter wafers.

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 Referenced Standards and Documents

3.1 *SEMI Standards and Safety Guidelines*

SEMI M1 — Specification for Polished Single Crystal Silicon Wafers

SEMI M8 — Specification for Polished Monocrystalline Silicon Test Wafers

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SEMI M24 — Specification for Polished Monocrystalline Silicon Premium Wafers

SEMI M31 — Specification for Mechanical Features of Front Opening Shipping Box Used to Transport and Ship 300 mm Wafers

SEMI M45 — Specification for 300 mm Wafer Shipping System

SEMI M59 — Terminology for Silicon Technology

SEMI T3 —Specification for Wafer Box Labels

SEMI T7 — Specification for Back Surface Marking of Double-Side Polished Wafers with a Two-Dimensional Matrix Code Symbol

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

4 Terminology

4.1 Most general terms, acronyms, and symbols relating to silicon technology are defined in SEMI M59.

5 Ordering Information

5.1 Purchase orders for reclaimed silicon wafers furnished to this Specification shall include the appropriate order entry information from Table 1, Silicon Wafer Specification Format for Order Entry, Parts 1 and 2, in SEMI M1.

5.1.1 All information in Part 1, General Information, and the following items from Part 2, Polished Wafer or Substrate, shall be included:

- 2-1.1 Growth Method.
- 2-1.3 Crystal Orientation.
- 2-1.4 Conductivity Type.
- 2-1.5 Dopant.
- 2-1.8 Wafer Surface Orientation.
- 2-2.1 Resistivity.
- 2-6.1 Diameter.
- 2-6.2 Fiducial Dimensions.
- 2-6.3 Primary Flat/Notch Orientation.
- 2-6.7 Thickness.

Other items shall be included as agreed between supplier and customer (indicated as ‘customer specified’ in the Tables 1, 2, and 3).

5.2 In addition, the purchase order shall indicate the test method to be used in evaluating each of those items for which alternate test procedures exist.

5.3 The following items shall be specified for reclaim wafer requirements:

5.3.1 Type of application provided in Tables 1, 2, and 3 (mechanical, furnace, particle, lithography, 180 or 130 nm).

5.3.2 A statement that the wafers are customer-supplied or third-party sourced,

5.3.3 Any requirements that differ from the tables.

5.3.4 *Wafer ID Marking*

5.3.4.1 For 300 mm wafers, whether the wafers are to be re-inscribed as specified in Appendix 1 or not,

5.3.5 Minimum removal requirements (if any),

5.3.6 Any requirements that differ from the tables, and

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5.3.7 Methods of testing specified attributes for which either no or multiple test methods exist (see ¶¶ 7.2 and 7.3).

5.4 The following items shall also be included in a purchase order:

5.4.1 Lot acceptance procedures,

5.4.2 Certification (if required), and

5.4.3 Packing and shipping container labeling requirements.

5.4.3.1 Note that for packing and marking of 300 mm wafers, the requirements of SEMI M31 and SEMI M45 shall be observed.

6 Requirements

6.1 Tables 1, 2, and 3 provide Specification for Polished Reclaimed Silicon Wafers for 2 inch, 3 inch, 100 mm, 125 mm, 150 mm, 200 mm, 300 mm Diameter, 180 nm, and 130 nm Design Rule Usages. A parameter not listed in these tables need not be specified.

6.2 It is also essential to specify appropriate test methods in each case. Defaults for test method selection are given in § 7.

6.3 The wafers shall be capable of being reconditioned for use.

NOTE 2: The line items with numbers beginning with '2-' are listed in Part 2 of the Silicon Wafer Specification Format for Order Entry, SEMI M1, Table 1.

7 Test Methods

7.1 Measurements shall be made or certifiable to one of the SEMI, ASTM, JEITA, JIS, or DIN standard test methods for the item as selected from the Silicon Wafer Specification Format for Order Entry, Part 2, located in Table 1 of SEMI M1, and specified in the purchase order.

7.2 If several different standard test methods for an item are commonly used within a region, it is particularly important that the applicable method of test be identified in the purchase order.

7.3 If no method of test is specified in the purchase order and if standard test methods from different geographic regions are available, the default method shall be a method in common usage for the region of the purchaser of the wafer.

7.4 If no standard test method for an item is available, the test procedure to be used shall be agreed upon between supplier and customer.

7.5 Information about the various test methods cited is provided in Related Information 2 of SEMI M1 together with information about some additional test methods no longer in wide use throughout the industry.

8 Certification

8.1 Upon request of the purchaser in the contract or order, a manufacturer's or supplier's certification that the material was manufactured and tested in accordance with this Specification, together with a report of the test results, shall be furnished at the time of shipment.

8.2 In the interest of controlling inspection costs, the supplier and the purchaser may agree that the material shall be certified as 'capable of meeting' certain requirements. In this context, 'capable of meeting' shall signify that the supplier is not required to perform the appropriate tests in § 7. However, if the customer performs the test and the material fails to meet the requirement, the material may be subject to rejection.

9 Packing and Marking

9.1 The wafers supplied under these specifications shall be identified by appropriately labeling the outside of each box or other container and each subdivision thereof in which it may reasonably be expected that the wafers will be stored prior to further processing. Identification shall include as a minimum the nominal diameter, conductivity type, dopant, orientation, resistivity range, and lot number. The lot number, either (1) assigned by the original manufacturer of the wafers, or (2) assigned subsequent to wafer manufacture but providing reference to the original lot number, shall provide easy access to information concerning the fabrication history of the particular wafers in that lot. Such

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information shall be retained on file at the manufacturer's facility for at least one month after that particular lot has been accepted by the customer.

9.2 Alternatively, if agreed upon between supplier and customer, one of the box labeling schemes in SEMI T3 shall be used and the information listed in ¶ 9.1 that is not included on the label shall be retained in the supplier's data base for at least one month after that particular lot has been accepted by the customer.

9.3 Wafers of 300 mm diameter shall be shipped in packages labeled in accordance with SEMI M45.

10 Packing and Shipping Container Labeling

10.1 Special packing requirements shall be subject to agreement between the supplier and the purchaser. Otherwise all wafers shall be handled, inspected, and packed in such a manner as to avoid chipping, scratches, and contamination, and in accordance with the best industry practices, to provide ample protection against damage during shipment.

10.2 Wafers of 300 mm diameter shall be shipped in the packaging and Labeling in accordance with SEMI M31 and SEMI M45.

Table 1 Specifications for 150, 200, and 300 mm Silicon Reclaim Wafers

	Item	*Mechanical*	*Furnace*	*Particle*	*Lithography*
2-1. GENERAL CHARACTERISTICS					
2-1.1	Growth Method	As-supplied			
2-1.3	Crystal Orientation	As-supplied			
2-1.4	Conductivity Type	As-supplied			
2-1.5	Dopant	As-supplied			
2-1.6	Nominal Edge Exclusion	Unspecified	Customer specified		
2-1.8	Wafer Surface Orientation	As-supplied			
2-2. ELECTRICAL CHARACTERISTICS					
2-2.1	Resistivity	Customer specified			
2-2.2	Radial Resistivity Variation (RRG)	Unspecified			
2-2.3	Resistivity Striations	Unspecified			
2-2.4	Minority Carrier Lifetime	Unspecified			
2-3. CHEMICAL CHARACTERISTICS					
2-3.1	Oxygen Concentration	Unspecified	As-supplied	Unspecified	
2-3.2	Radial Oxygen Variation	Unspecified	As-supplied	Unspecified	
2-3.3	Carbon Concentration	Unspecified	As-supplied	Unspecified	
2-4. STRUCTURAL CHARACTERISTICS					
2-4.1	Dislocation Etch Pit Density	Unspecified			None
2-4.2	Slip	Unspecified	None		
2-4.3	Lineage	Unspecified	None		
2-4.4	Twin Boundary	Unspecified	None		
2-4.5	Swirl	Unspecified			
2-4.6	Shallow Pits	Unspecified			
2-4.7	Oxidation Induced Stacking Faults (OSF)	Unspecified			
2-4.8	Oxide Precipitates, BMD	Unspecified			
2-5. WAFER PREPARATION CHARACTERISTICS					
2-5.1	Wafer ID Marking	Customer specified			
2-5.2	Front Surface Thin Film(s)	Unspecified	None	Unspecified	None
2-5.3	Denuded Zone	Unspecified			

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	Item	*Mechanical*	*Furnace*	*Particle*	*Lithography*
2-5.4	Extrinsic Gettering	Unspecified	None	Unspecified	None
2-5.5	Backseal	Unspecified	None	Unspecified	None
2-5.6	Annealing	Unspecified			
2-5.7	Edge Surface Condition	150 mm: Unspecified			
		200 mm and 300 mm: Unspecified	200 mm and 300 mm: Customer specified		
2-6. DIMENSIONAL CHARACTERISTICS					
2-6.1	Diameter	150 mm ± 0.50 mm, 200 mm ± 0.50 mm, 300 mm ± 0.50 mm			
2-6.2	Fiducial Dimensions	As-supplied			
2-6.3	Primary Flat/Notch Orientation	As-supplied			
2-6.4	Secondary Flat Length	As-supplied			
2-6.5	Secondary Flat Location	As-supplied			
2-6.6	Edge Profile	Unspecified			
2-6.7	Thickness	150 mm (SEMI M1, Categories 1.8.1 and 1.8.2): 533–675 µm, 150 mm (SEMI M1, Categories 1.13.1 and 1.13.2): 585–725 µm, 200 mm (SEMI M1, Categories 1.9.1, 1.9.2, and 1.9.3): 600–775 µm, 300 mm (SEMI M1, Category 1.15): 650–800 µm			
2-6.8	Total Thickness Variation (TTV)	Unspecified			
2-6.9	Bow	Unspecified			
2-6.10.	Warp	Unspecified			
2-6.11	Sori	Unspecified			Customer specified
2-6.12	Flatness, Global	Unspecified			Customer specified
2-6.13	Flatness, Site	Unspecified			Customer specified
2-7. FRONT SURFACE CHEMISTRY					
2-7.1	Surface Metal Contamination				
2-7.1.1	Sodium	Unspecified	Customer specified	Unspecified	
2-7.1.2	Aluminum	Unspecified	Customer specified	Unspecified	
2-7.1.3	Potassium	Unspecified	Customer specified	Unspecified	
2-7.1.4	Chromium	Unspecified	Customer specified	Unspecified	
2-7.1.5	Iron	Unspecified	Customer specified	Unspecified	
2-7.1.6	Nickel	Unspecified	Customer specified	Unspecified	
2-7.1.7	Copper	Unspecified	Customer specified	Unspecified	
2-7.1.8	Zinc	Unspecified	Customer specified	Unspecified	
2-7.3	Surface Organics	Unspecified			

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