SEMI P37-1101
SPECIFICATION FOR EXTREME ULTRAVIOLET LITHOGRAPHY MASK SUBSTRATES

This standard was technically approved by the Micropatterning Global Technical Committee and is the direct responsibility of the North American Micropatterning Committee. Current edition approved by the North American Regional Standards Committee on August 27, 2001. Initially available at www.semi.org September 2001; to be published November 2001.

1 Purpose

1.1 This specification covers the general requirements of the substrate for extreme ultraviolet lithography (EUVL) masks.

2 Scope

2.1 This standard details the physical characteristics required for EUVL mask substrates. The specific material is not specified to allow for innovation in materials and substrates.

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

3.1 *ISO Standard*[1]

ISO 14644-1 — Cleanrooms and Associated Controlled Environments Part 1: Classification of Air Cleanliness

3.2 *ANSI Standard*[2]

ANSI/ASQC Z1.4 — Sampling Procedures and Tables for Inspection by Attributes

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

4 Terminology

4.1 None.

5 Ordering Information

5.1 Purchase orders for EUVL mask substrates furnished to this specification shall include the following:

5.1.1 Material coefficient of thermal expansion (see § 7);

5.1.2 Defect quality area dimensions and defect limits (see § 9); and

5.1.3 Lot acceptance criteria (see § 10).

6 Dimensions and Permissible Variations

6.1 The square substrates shall conform to the dimensional tolerances appropriate to the nominal edge length and thickness as listed in Table 1. Dimensions are illustrated in Figure 1.

6.2 Substrates shall have chamfered or rounded edges. The edges shall conform to the dimensional tolerances appropriate to the nominal thickness listed in Table 2. Dimensions are illustrated in Figure 1.

6.3 Substrates shall be identified with notches at three corners on the backside of the substrate as shown in Figure 1. Dimensions of notches shall be as defined in Figure 1.

[1] International Organization for Standardization, ISO Central Secretariat, 1 rue de Varembé, Case postale 56, CH-1211 Geneva 20, Switzerland; Telephone: 41.22.749.01.11, Fax: 41.22.733.34.30, http://www.iso.ch

[2] American Society for Quality, 600 North Plankinton Avenue, Milwaukee, WI 53203, USA; Telephone: 414.272.8575, Fax: 414.272.1734, http://www.asq.org

SUPERSEDED
Documents Document Sharing Hub
Full document details: SEMI P37-1101

6.4 Figure 2 shows three datum points on the edges of the mask substrate. Three datum points are also shown on the back surface of the mask substrate. These datum points serve as reference locations for all dimensional measurements listed in Table 1.

7 Material Specifications

7.1 Substrate materials shall be identified as near zero thermal expansion (NZTE). Examples of NZTE materials are titania doped silica glass or two phase glass ceramics.

7.2 Substrate materials shall conform to thermal expansion characteristics defined in Table 3 over the entire range of temperature listed and at all spatial points within the substrate.

7.2.1 The thermal expansion properties of the substrate are defined in four classes. The particular class of thermal expansion material used shall be agreed upon between user and supplier. The thermal expansion properties of the substrate are defined over the entire temperature range shown in Table 3.

7.2.2 Table 3 defines the permissible range of the mean and the permissible range of the coefficient of thermal expansion.

7.3 The substrate material shall have specific stiffness as defined in Table 3.

7.4 Selected physical properties of NZTE materials are provided for information only in Appendix 1.

7.5 The front, sides, and or back surfaces of the substrate may be coated with layers that are agreed upon between user and supplier. The substrate including these optional additional layers must meet all requirements outlined in this standard.

8 Flatness Specifications

8.1 Substrates shall be supplied with front and back sides having flatness as listed in Table 4 over a flatness quality area as defined in Figure 3. The flatness error is defined as the deviation of the surface from the plane that minimizes the maximum deviation, which is illustrated in Figure 4.

8.2 The global flatness requirement for the front and back sides, which includes the region excluded from the flatness quality area (defined in Figure 3), is shown in Table 4.

8.3 Substrates shall be supplied with wedge angle defined in Table 4 and defined in Figure 5.

8.4 Substrates shall be supplied with local slope angle as defined in Table 4 and defined in Figure 4.

8.5 A low order thickness variation (LOTV) requirement is defined over a range of spatial periods (shown in Table 4) composing the surface profile power spectral density. This thickness variation may be determined from the residual flatness error of the front and back surfaces after removing the wedge angle from the data.

8.6 The surface roughness requirements for the front and backside are listed in Table 4, and they are defined over a range of spatial periods.

9 Visual Criteria

9.1 A defect quality area, which may or may not correspond with the flatness area, shall be agreed upon between the user and supplier. Figure 6 shows the labeling of the dimensions of the defect quality area.

9.2 Each plate shall not have more defects than listed in Table 5 inside the defect quality area defined in Figure 6 on the front side. Dimensions of the quality area shall be agreed upon between user and supplier. Each plate shall not have more defects than listed in Table 5 outside the defect quality area defined in Figure 6 on the front side.

9.3 Each plate shall not have more defects than listed in Table 5 on the back side within the flatness quality area defined in Figure 3.

10 Sampling

10.1 Unless otherwise specified, appropriate sample sizes shall be selected from each lot in accordance with ASQC Z1.4. Each quality characteristic shall be assigned an acceptable quality level (AQL) in accordance with ASQC Z1.4 definitions for critical, major, and minor classifications. If desired, and so specified in the contract or order, each of

SUPERSEDED

Documents
Document Sharing Hub
Full document details: SEMI P37-1101

these classifications may alternatively be assigned cumulative AQL values. Inspection levels shall be agreed upon between user and supplier.

11 Test Methods

11.1 *Thermal Expansion* — To be agreed upon between user and supplier.

11.2 *Flatness and Wedge Angle* — To be agreed upon between user and supplier.

11.3 *Visual* — To be agreed upon between user and supplier.

11.4 *Surface Roughness* — To be agreed upon between user and supplier.

12 Certification

12.1 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.

13 Packing and Marking

13.1 Substrates shall be packed in a class 1 environment as defined by ISO 14644-1. Containers shall be designed to protect the substrates from contamination in handling and transit. Substrates shall be shipped with the acceptable flatness side toward the front of the box. This orientation shall be indicated on each container. Packaging shall comply with the applicable internal, national, state, and local laws and regulations required for shipping.

13.2 Containers shall be labeled "Warning: Open and Handle Under Cleanroom Conditions Only" as well as identified by user purchase order number (if applicable), drawing number (if applicable), quantity, supplier lot number, and material identification.

SUPERSEDED

Documents Document Sharing Hub
Full document details: SEMI P37-1101