SEMI P48-1110 (Reapproved 0416)
SPECIFICATION OF FIDUCIAL MARKS FOR EXTREME ULTRAVIOLET MASK BLANK

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NOTICE: This Document was reapproved with minor editorial changes.

1 Purpose

1.1 This Standard specifies key requirements of fiducial marks that can be used as a coordinate system for referencing defect locations on extreme ultraviolet (EUV) blanks.

2 Scope

2.1 This Standard is intended to set an appropriate level of technical specifications of mask fiducial marks, such as their locations, shapes, sizes, line dimensions, and limits of variation. The marks must be readable by mask metrology and pattern write tools. This Standard is not intended to specify how to use the fiducial marks to locate defects on EUV blanks.

2.2 This Standard does not specify techniques to be used or how the fiducial marks are generated.

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 E152 — Specification of EUV Pod for 150 mm EUVL Reticle

SEMI P1 — Specification for Hard Surface Photomask Substrates

SEMI P37 — Specification for Extreme Ultraviolet Lithography Substrates and Blanks

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

4 Terminology

4.1 *Abbreviations and Acronyms*

4.1.1 *CD* — critical dimension

4.1.2 *CDL* — charging dissipation layer

4.1.3 *EUV* — extreme ultraviolet

4.1.4 *EUVL* — extreme ultraviolet lithography

4.1.5 *FMPS* — fiducial mark placement square

4.1.6 *LER* — line edge roughness

4.2 *Definitions*

4.2.1 *absorber film stack* — stack of film layers deposited on top of the multilayer film stack to block reflection of EUV light in desired areas, with optional buffer layer for use in some absorber repair operations.

4.2.2 *backside of EUV blank* — the side of the EUV blank with the conductive layer.

4.2.3 *cross* — a cross consists of two bisecting lines perpendicular to each other. The large and small crosses are relative to each other in size.

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4.2.4 *EUV mask blank (or EUV blank)* — an EUV substrate upon which a conductive layer is deposited on the backside, and a multilayer film and an absorber film stack on the other side.

4.2.5 *EUV mask substrate (or EUV substrate)* — the base glass or ceramic material upon which films are deposited to make EUV blanks and EUV masks. It is identified with notches or bevels of the required dimensions at three corners on its backside, as specified in SEMI P37.

4.2.6 *EUV multilayer film stack* — stack of film layers deposited on the EUV substrate to provide high EUV reflectivity, and any capping layers for environmental protection or etch stops.

4.2.7 *fiducial mark* — a set of marks on EUV blanks, such as large and small crosses.

4.2.8 *fiducial mark location* — center of the large cross of fiducial mark on EUV blanks.

4.2.9 *fiducial mark placement square (FMPS)* — a square formed by virtual lines connecting the locations of four fiducial marks on EUV blanks.

4.2.10 *frontside of EUV blank* — the side of the EUV blank with the multilayer and absorber film stack.

5 Requirements

5.1 *Fiducial Mark Layout Requirements*

5.1.1 Fiducial marks are fabricated on the frontside of EUV blanks prior to absorber deposition, onto either the substrate or multilayer film stack.

5.1.2 Fiducial marks consist of one large cross and either two small crosses or one small cross as shown in Figure 1(a) and (b).

5.1.3 Both the distances between large and small crosses and their relative positions are specified in Figure 1 and Table 1 by $x1$, $y1$.

5.1.4 The dimensions of large crosses are defined in Figure 1 and Table 1 by $x2$, $y2$, and critical dimension (CD).

5.1.5 The dimensions of small crosses are defined in Figure 1 and Table 1 by $x3$, $y3$, and CD.

5.1.6 EUV blanks have four fiducial marks, one at each corner of EUV blanks as shown in Figure 2.

5.1.7 Fiducial mark placed at the unbeveled corner of EUV blanks must have one small cross as shown in Figures 1(b) and 2.

5.1.8 Fiducial marks placed at the beveled corners of EUV blanks must have two small crosses, as shown in Figures 1(a) and 2.

5.1.9 Relative positions between fiducial marks are defined in Figure 2 and Table 1 by $x4$, $y4$ and fiducial mark placement square (FMPS) orthogonality.

5.1.10 FMPS parallelism is referenced to edges of EUV blanks. The parallelism is specified to ≤0.200/136.000 as shown in Table 1.

5.1.11 Location of the fiducial mark on EUV blanks at the unbeveled corner is specified in Figure 2 and Table 1 by $x5$, $y5$.

5.1.12 Locations of the fiducial marks on EUV blanks at beveled corners are constrained in Figure 2 and Table 1 by $x4$, $y4$, $x5$, $y5$, FMPS orthogonality, FMPS parallelism, and dimensional specification of EUV substrates as defined in SEMI P37.

5.1.13 Fiducial marks must be properly aligned so that the center of small crosses coincide with lines of the FMPS as shown in Figure 2.

5.1.14 The area inside the FMPS square must be free of marks or crosses as shown in Figure 2.

5.1.15 Exclusion zones for placement of user-defined fiducial marks are shown hatched in Figure 2. The zones are specified in Figure 2 and Table 1 by $x4$, $y4$, $x6$, $y6$, $x7$, $y7$.

5.1.16 Any user-defined fiducial marks must be placed inside exclusion zones and at least 1.000 mm away from small crosses of fiducial marks.

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