

SEMI MF523-1107 (Reapproved 0718) PRACTICE FOR UNAIDED VISUAL INSPECTION OF POLISHED SILICON WAFER SURFACES

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1 Purpose

1.1 Large volumes of polished silicon wafers are produced by the semiconductor industry and consumed in the production of various devices. Surface defects are frequently deleterious to device properties.

1.2 The defects described in this Practice are visible to the unaided eye under proper lighting conditions, and the inspections are common to most consumers and producers. Therefore, it is important that a uniform inspection technique be used to aid in the manufacture of standard-quality polished silicon wafers.

2 Scope

2.1 This Practice covers an inspection procedure for determining the surface quality of silicon wafers that have been polished on one side.

2.2 This Practice is intended as a large-volume acceptance method and does not require use of a microscope or other optical instruments. The inspection relies heavily on the visual acuity of the operator; therefore, test results may be very operator-sensitive.

NOTE 1: For clarification of the identification of certain observed defects, illustrations are given in SEMI MF154.

2.3 Defects visible to the unaided eye on polished wafer surfaces are categorized in three groups by the illumination geometry that best delineates them: front-surface high-intensity light, front-surface diffuse light and back-surface diffuse light. These defects originate from two sources: (1) imperfections in the silicon crystal, and (2) damage from the manufacturing process, including handling and packaging.

2.4 The inspection described generally takes place after polishing and post-polish cleaning but before packaging. Although cleaning and packaging procedures are not a part of this Practice, the inspection may be performed on a packaged product to determine the effect of such procedures on the quality of the polished wafers.

2.5 The values stated in SI 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 The polished front surface of a silicon wafer can be damaged by any one of a multitude of types of particulate matter normally occurring in the environment. After cleaning, polished wafers must be kept in a clean room or clean-air environment at all times prior to being sealed in packaging. Failure to do this can compromise the quality of a polished wafer.

3.2 The operator in many instances is the most common source of added contamination to the wafer. Coughing, sneezing or even talking can be the source of additional contaminants. Effort must be taken to minimize the operator-induced contamination through rigorous clean room practice.

3.3 Tweezers may introduce defects into the polished wafer surface and therefore are not suitable for use with this method.

NOTE 2: The recommended handling method is by means of a manually vacuum pencil (see ¶ 7.5) or a robotic pickup tool. Both techniques will be referred to as the pickup device in this Practice.

3.4 **WARNING:** During the front-surface, high-intensity light inspection, any light reflected by the specimen or surroundings into the operator's eyes will greatly reduce the operator's visual acuity and effectiveness. This exposure may also cause eye injury.

3.5 Improper cleaning and packaging methods following this inspection can compromise otherwise acceptable polished wafers.

NOTE 3: It is suggested that wafer suppliers periodically sample their packaged product to determine that packaging is not degrading the polished wafers.

4 Referenced Standards and Documents

4.1 SEMI Standards and Safety Guidelines

SEMI C41 — Specification and Guide for 2-Propanol

SEMI M59 — Terminology for Silicon Technology

SEMI MF154 — Guide for Identification of Structures and Contaminants Seen on Specular Silicon Surfaces

4.2 ISO Standard¹

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 Practice

6.1 The polished surface is first illuminated with a high-intensity source of light positioned so that the light beam is normal to the surface. With the background illumination at a specified low level, the surface is observed at an oblique angle. Under this viewing condition, defects that act as localized light scatters (light-scattering points) are detected.

6.2 Next, the polished surface is illuminated with a large-area diffuse light source. With the same low level of background illumination, the surface is again observed at an oblique angle. Under this viewing condition, defects larger than those observable under intense collimated light are detected.

6.3 Finally, the wafer is turned over, and the back surface is inspected for the presence of large-area defects with the surface illuminated by the large-area diffuse source.

6.4 Identification of the specimen and the presence of defects are recorded.

7 Apparatus

7.1 *High-intensity Light Source* — Quartz halogen lamp with collimated beam intensity greater than 230 klx (22,000 fc).

NOTE 4: Some standard 35 mm slide projectors meet these requirements. A slide projector system with F/2.8, 127 mm lens and 300 W quartz halogen lamp is well suited for this application. The beam is not collimated, but has a very long focal length approximating collimation. The projector cooling fan must be properly exhausted from the particle free inspection area.

7.2 *Clean-Air Hood* — Located in a clean room environment of the Class 7 requirements of ISO 14644-1 or better consistent with the particle levels being inspected on the wafers. The inspection area should have an ambient light level of 50 to 650 lx (5 to 60 fc) 230 mm (9 in.) from the front edge of the hood.

7.3 *Large-Area, Diffuse Light Source* — Adjustable, to provide a light intensity of approximately 430 to 650 lx (40 to 60 fc) at the inspection point.

NOTE 5: This source may be contained within the active volume of the clean-air hood as an integral part. Fluorescent illumination is preferred because it can achieve an even illumination over large areas more satisfactorily than can incandescent illumination. In

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