

SEMI M16-1110 (Reapproved 1121) SPECIFICATION FOR POLYCRYSTALLINE SILICON

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NOTICE: Paragraphs entitled ‘NOTE:’ are not an official part of this Standard or Safety Guideline and are not intended to modify or supersede the official Standard or Safety Guideline. These have been supplied by the global technical committee to enhance the usage of the Standard or Safety Guideline.

NOTICE: The section symbol (§) is used to reference a numbered section, paragraph, or header and all subordinate paragraphs, headers, and embedded material (i.e., EXCEPTIONs, lists) therein. The paragraph symbol (¶) is used to reference a particular numbered paragraph and embedded material therein. When duplicated (i.e., §§ and ¶¶) the symbols are used to reference more than one section or paragraph, respectively.

1 Purpose

1.1 This Specification is intended for use in procurement of polycrystalline silicon for growth of electronic grade monocrystalline silicon ingots. Such ingots are sliced into wafers that are subsequently used for the production of semiconductor devices, integrated circuits, and other microelectronic components including microelectromechanical systems (MEMS).

2 Scope

2.1 This Specification covers requirements for polycrystalline silicon (poly) used to produce single crystal silicon by either the modified Czochralski (Cz) or float zone (FZ) crystal growth technique for applications in the semiconductor device industry.

2.2 Form and dimensional characteristics are the only standardized properties set forth below. A purchase specification may include requirements for additional physical properties as listed in this Specification, together with test methods suitable for determining their magnitudes.

NOTE 1: JEITA has also established a specification for polysilicon.¹ This Specification also includes specification limits and specified measurement methods for purity and surface metal contamination. Similarities and differences between this Standard and JEITA EM-3601A are discussed in Related Information 1.

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 M59 — Terminology for Silicon Technology

SEMI MF1708 — Practice for Evaluation of Granular Polysilicon by Melter-Zoner Spectroscopies

SEMI MF1723 — Practice for Evaluation of Polycrystalline Silicon Rods by Float-Zone Crystal Growth and Spectroscopy

SEMI MF1724 — Test Method for Measuring Surface Metal Contamination of Polycrystalline Silicon by Acid Extraction-Atomic Absorption Spectroscopy

¹ Japan Electronics and Information Technology Industries Association, Ote Center Building, 1-1-3, Otemachi, Chiyoda-ku, Tokyo 100-0004, Japan; <http://www.jeita.or.jp>

3.2 ANSI Standard²

ANSI/ASQ Z1.4-1993 — Sampling Procedures and Tables for Inspection by Attributes

3.3 ASTM Standards³

ASTM E122 — Standard Practice for Calculating Sample Size to Estimate, With Specified Precision, the Average for a Characteristic of a Lot or Process

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

4 Terminology

4.1 Acronyms, terms, and symbols related to silicon technology, including most of those used in this Specification, are listed and defined in SEMI M59.

4.2 Other Definitions Used in this Standard

4.2.1 *etched polysilicon* — polysilicon that has been etched with acid to remove surface contamination.

4.2.2 *lot* — all of the material of nominally identical purity and characteristics contained in a single shipment, manufactured with similar processing conditions, and traceable to the manufacturing conditions. A lot may be further defined as the polysilicon produced from one reactor run.

4.2.3 *polycrystalline silicon* — silicon, formed by chemical vapor deposition from a silicon source gas, having a structure that contains large angle grain boundaries, twin boundaries, or both. Also known as poly, or polysilicon.

NOTE 2: Note that this definition for polysilicon is extended from that given in SEMI M59.

5 Ordering Information

5.1 Purchase orders for polysilicon furnished to this Specification shall include the following items:

- 5.1.1 Form (nugget, granular, or rod),
- 5.1.2 Shape and size distribution (nugget form only),
- 5.1.3 Purity,
- 5.1.4 Surface texture (nugget form only),
- 5.1.5 Surface condition,
- 5.1.6 Optionally; surface metal contamination,
- 5.1.7 Appearance,
- 5.1.8 Lot acceptance procedures (see § 8),
- 5.1.9 Certification (if required) (see § 10),
- 5.1.10 Packing and marking (see § 11).

6 Materials and Manufacture

6.1 The material shall consist of polysilicon with the form specified in the purchase order or contract.

7 Physical Requirements

7.1 The material shall conform to the properties specified in the purchase order or contract, as follows (see Table 1):

- 7.1.1 Shape and size distribution (nugget form only),
- 7.1.2 Purity,

² American National Standards Institute, 25 West 43rd Street, New York, NY 10036, USA; Telephone: +1.212.642.4900, Fax: +1.212.398.0023, <http://www.ansi.org>

³ ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, USA; Telephone: +1.610.832.9585, Fax: +1.610.832.9555, <http://www.astm.org>

- 7.1.3 Surface texture (nugget form only),
- 7.1.4 Surface condition,
- 7.1.5 Surface metal contamination; if specified,
- 7.1.6 Appearance.

8 Sampling

8.1 Unless otherwise specified, ASTM E122 shall be used. When so specified, appropriate sample sizes shall be selected from each lot in accordance with ANSI/ASQ Z1.4-1993. Inspection levels shall be agreed upon between the supplier and the purchaser.

9 Test Methods

9.1 *Shape and Size Distribution (Nugget Form Only)* — Determine by methods agreed upon by the purchaser and the supplier.

9.2 *Purity* — For nugget and rod forms, determine in accordance with SEMI MF1723. For granular form, determine in accordance with SEMI MF1708.

9.3 *Surface Texture (Nugget Form Only)* — Determine by a method agreed upon by the purchaser and the supplier. Visual limit standards shall be used to describe acceptable limits.

9.4 *Surface Metal Contamination, if Specified* — Determine in accordance with SEMI MF1724.

9.5 *Surface Condition* — Identify as to whether or not the surface has been etched.

9.6 *Appearance* — Inspect visually for stains, discoloration, and visible contamination.

10 Certification

10.1 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 the specification shall be furnished at the time of shipment (Certificate of Compliance). Upon request, a report of the test results may also be required (Certificate of Analysis).

10.2 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 test indicated in § 9. However, if the purchaser performs the test and the material fails to meet the requirement, the material may be subject to rejection.

11 Packing and Marking

11.1 Special packing requirements shall be subject to agreement between the supplier and purchaser. Otherwise all poly shall be handled, inspected, and packed in bags and boxes in such a manner as to minimize abrasion, chipping, and contamination, and in accordance with the best industry practices to provide ample protection against damage during shipment.

11.2 The poly supplied under the specification shall be identified by appropriately labeling the outside of each box and each bag therein. Identification shall include, as a minimum, the weight and lot number of the polysilicon. The lot number shall provide traceability to information concerning the manufacturing history of the particular poly in that lot. Such information shall be kept on file at the manufacturer's facility for at least three years after that particular lot has been accepted by the purchaser.

12 Related Documents

12.1 The following SEMI Standards, cited in SEMI MF1708 and SEMI MF1723 are required to perform the tests described in those practices:

SEMI MF1389 — Test Methods for Photoluminescence Analysis of Single Crystal Silicon for III-V Impurities

SEMI MF1391 — Test Method for Substitutional Carbon Content of Silicon by Infrared Absorption

SEMI MF1630 — Test Method for Low Temperature FT-IR Analysis of Single Crystal Silicon for III-V Impurities