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Solar-grade polycrystalline silicon

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Solar-grade polycrystalline silicon

1 Scope

This standard specifies the terms and definitions, grades and classifications, requirements, test methods, inspection rules, marking, packaging, transportation, storage, and quality certificates of solar-grade polycrystalline silicon.

This standard applies to rod-shaped polycrystalline silicon grown from chlorosilane and silane or polycrystalline silicon blocks formed by crushing.

2 Normative references

The following documents are essential to the application of this document. For the dated referenced documents, only the versions with the indicated dates are applicable to this document; for the undated referenced documents, only the latest version (including all the amendments) is applicable to this document.

GB/T 1550 Test methods for conductivity type of extrinsic semiconducting materials

GB/T 1551 Test method for measuring resistivity of monocrystal silicon - In-line four-point probe and direct current two-point probe method

GB/T 1553 Test methods for minority carrier lifetime in bulk silicon and germanium - Photoconductivity decay method

GB/T 1557 Test method for determining interstitial oxygen content in silicon by infrared absorption

GB/T 1558 Test method for substitutional atomic carbon content of silicon by infrared absorption

GB/T 4059 Test method for phosphorus content in polycrystalline silicon by zone-melting method under controlled atmosphere

GB/T 4060 Test method for boron content in polycrystalline silicon by vacuum zone-melting method

GB/T 13389 Practice for conversion between resistivity and dopant density for boron-doped, phosphorus-doped, and arsenic-doped silicon

GB/T 14264 Semiconductor materials - Terms and definitions

GB/T 14844 Designations of semiconductor materials

GB/T 24574 Test methods for photoluminescence analysis of single crystal silicon for III-V impurities

GB/T 24581 Test method for III and V impurities content in single crystal silicon - Low temperature FT-IR analysis method

GB/T 24582 Test method for measuring surface metal impurity content of polycrystalline silicon - Acid extraction-inductively coupled plasma mass spectrometry method

GB/T 29057 Practice for evaluation of polycrystalline silicon rods by float-zone crystal growth and spectroscopy

GB/T 29849 Test method for measuring surface metallic contamination of silicon materials used for photovoltaic applications by inductively coupled plasma mass spectrometry

GB/T 31854 Test method for measuring metallic impurities content in silicon materials used for photovoltaic applications by inductively coupled plasma mass spectrometry

3 Terms and definitions

The terms and definitions defined in GB/T 14264 apply to this document.

4 Grade and classification

4.1 Grade

The grades of solar-grade polycrystalline silicon products shall meet the requirements of GB/T 14844.

4.2 Classification

Solar-grade polycrystalline silicon is divided into block and rod according to the shape, divided into N-type and P-type according to the conductivity type, and divided into four grades according to the difference in technical indexes.

5.3 Surface quality

5.3.1 No-need-to-cleaning or after-cleaning polycrystalline silicon shall meet the requirements for direct use. The classification requirements for the surface quality of polycrystalline silicon are generally as follows:

a) Dense polysilicon: The depth of surface particle dimples is less than 5 mm, the cross-sectional structure is dense, the appearance has no abnormal color, and there is no oxidized interlayer;

b) Popcorn polysilicon: The depth of surface particle dimples is 5 mm~20 mm, the appearance has no abnormal color, and there is no oxidized interlayer;

c) Coral polysilicon: The cross-sectional structure is loose, the depth of surface particle dimple is ≥20 mm, the appearance has no abnormal color, and there is no oxidized interlayer.

5.3.2 Other classification requirements for the surface quality of polycrystalline silicon shall be agreed upon between the supplier and the purchaser.

6 Test method

6.1 Before the test of donor impurity concentration, acceptor impurity concentration, oxygen concentration, carbon concentration, minority carrier lifetime, conductivity type, and resistivity of polycrystalline silicon, single crystal samples are required to be prepared according to the methods specified in GB/T 4059, GB/T 4060 or GB/T 29057.

6.2 The determination of donor impurity concentration and acceptor impurity concentration in polycrystalline silicon shall be carried out according to the provisions of GB/T 24574 or GB/T 24581, or converted according to the methods specified in GB/T 1551 and GB/T 13389. Arbitration inspection shall be carried out in accordance with the provisions of GB/T 24581.

6.3 The determination of oxygen concentration in polycrystalline silicon shall be carried out according to the provisions of GB/T 1557.

6.4 The determination of carbon concentration in polycrystalline silicon shall be carried out according to the provisions of GB/T 1558.

6.5 The determination of minority carrier lifetime in polycrystalline silicon shall be carried out according to the provisions of GB/T 1553.

6.6 The determination of the metal impurity content of the polycrystalline silicon matrix shall be carried out in accordance with the provisions of GB/T 31854.

6.7 The determination of the metal impurity content on the surface of polycrystalline silicon shall be carried out according to the provisions of GB/T 24582 or GB/T 29849. Arbitration inspection shall be carried out according to the provisions of GB/T 29849.

6.8 The inspection of the conductivity type of polycrystalline silicon shall be carried out according to the provisions of GB/T 1550.

6.9 The determination of the resistivity of polycrystalline silicon shall be carried out according to the provisions of GB/T 1551.

6.10 The dimension distribution range of polycrystalline silicon blocks shall be inspected by sieving, or by a method agreed upon by the supplier and the purchaser. The dimensions of the rod-shaped polycrystalline silicon are measured with a measuring tool of corresponding precision.

6.11 The surface quality of polycrystalline silicon is inspected visually.

7 Inspection rules

7.1 Inspection and acceptance

7.1.1 The product shall be inspected by the quality supervision department of the supplier to ensure that the product quality complies with the provisions of this standard; the product quality certificate shall be filled in.

7.1.2 The buyer can inspect the received products. If the test results are inconsistent with the provisions of this standard, it shall be reported to the supplier within 3 months from the date of receipt of the product, and the supplier and the buyer shall negotiate to resolve it.

7.2 Batch formation

Products shall be submitted for acceptance in batches, and each batch shall be composed of polycrystalline silicon of the same grade, which is produced under similar process conditions and traceable to the production conditions.

7.3 Inspection items

7.3.1 Each batch of products shall be inspected for donor impurity concentration, acceptor impurity concentration, oxygen concentration, carbon concentration, minority carrier lifetime, dimensions, and surface quality.

7.3.2 The matrix metal impurity content and the surface metal impurity content are the items of type inspection, and the inspection frequency is determined through negotiation between the supplier and the buyer.

c) the product quantity and net weight.

8.2 Packaging

The polycrystalline silicon shall be put into a clean high-purity resin packaging bag and sealed, and the dense polysilicon shall be packed into a double-layer clean packaging bag; then, the packaging bag is put into a packing box or drum. The packaging for polycrystalline silicon blocks is based on customer requirements; the rod-shaped polycrystalline silicon is fixed in a box and sealed with double-layer clean high-purity resin packaging bags. When packaging, the packaging bag shall be prevented from being damaged to avoid external contamination of the product and provide good protection.

8.3 Transportation

During transportation, the product shall be loaded and unloaded lightly, not pressed or squeezed, and anti-shock measures shall be taken.

8.4 Storage

The product shall be stored in a clean and dry environment.

8.5 Quality certificate

Each batch of products shall be accompanied by a quality certificate stating:

a) the supplier’s name;

b) the product name and grade;

c) the product batch number;

d) the gross weight and net weight of the product;

e) inspection results of all items and inspection department stamps;

f) the number of this standard;

g) the date of manufacture.

9 Contents of an order form (or contract)

The order form for the products listed in this standard shall include the following contents:

a) the product name;

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