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High purity opaque quartz glass

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Table of Contents

High purity opaque quartz glass

1 Scope

This document specifies the classification, requirements, test methods, inspection rules, marking, packaging, transportation, and storage of high-purity opaque quartz glass.

This document is applicable to high-purity opaque quartz glass materials with thermal insulation in semiconductor, photovoltaic, and other fields.

2 Normative references

The following documents contain the provisions which, through normative reference in this document, constitute the essential provisions 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 191 Packaging - Pictorial marking for handling of goods

GB/T 3284 Analytical method of the chemical composition in the quartz glass

GB/T 5432 Test method for density of glass by buoyancy

GB/T 10701-2008 Test methods for thermal stability of silica glass

GB/T 22588 Determination of thermal diffusivity or thermal conductivity by the flash method

JC/T 2205 Terminology of quartz glass

3 Terms and definitions

The terms and definitions defined in JC/T 2205 apply to this document.

4 Grades

According to product appearance quality and impurity element content, it is divided into semiconductor grade and photovoltaic grade.

5 Requirements

5.1 Specifications, dimensions, and dimensional deviations

They are negotiated by the supply and demand sides.

5.2 Appearance quality

5.2.1 The surface shall be smooth, uniform in color, and free from cracks, regular microcracks, and scratches with a length greater than 10 mm or a width greater than 0.5 mm.

5.2.2 Visually it is milky white, and there shall be no transparent areas.

5.2.3 Semiconductor-grade high-purity opaque quartz glass shall not have speck spots, coloured spots, and raw material particles; photovoltaic-grade high-purity opaque quartz glass shall not have speck spots, coloured spots, and raw material particles with a diameter greater than 1 mm, and the total number of speck spots, coloured spots, and raw meal particles, whose diameters are not greater than 1 mm, in any area of 100 cm^2 shall not exceed 4.

5.3 Density

The density shall not be greater than 2.15 g/cm^3 and not less than 1.90 g/cm^3.

5.4 Spectra transmittance

The spectra transmittance in the wavelength range of 380 nm~3000 nm shall be less than 1.0%.

5.5 Thermal stability

After the test, there shall be no cracks, breaches, or skin flake-off.

5.6 Heat resistance

The deformation rate after the test shall not exceed 2.0%.

5.7 Thermal conductivity

At 20 ℃, the thermal conductivity shall not be greater than 1.25 W/(m • K) and not less than 1.00 W/(m • K).

5.8 Content of impurity elements

The impurity elements include aluminum (Al), iron (Fe), calcium (Ca), magnesium (Mg), titanium (Ti), copper (Cu), cobalt (Co), nickel (Ni), manganese (Mn), lithium

Clean the sample in an ultrasonic bath, then wipe it clean with alcohol, rinse it with deionized water, and dry it naturally; then, carry out the test according to the method specified in GB/T 5432, and round the results to two decimal places.

6.5 Spectra transmittance

6.5.1 Sample

Take one piece of sample; the length and width are about 50 mm, the thickness after grinding is 5 mm±0.5 mm, and there are no obvious speck spots, coloured spots, raw material particles, or other defects that affect the test.

6.5.2 Test equipment

The requirements for the spectrophotometer:

a) It is able to measure the spectra transmittance of regular light;

b) The wavelength includes the range of 380 nm~3000 nm;

c) The transmittance measurement accuracy is not less than ±1%.

6.5.3 Test procedure

The test is carried out as follows:

a) Wipe the surface of the sample with alcohol until it is clean, rinse it with deionized water, and dry it at 110 °C±5 °C;

b) Use a spectrophotometer to measure the spectra transmittance of the sample in the range of 380 nm~3000 nm for regular light.

6.5.4 Data processing

Read the maximum transmittance value and round the result to one decimal place.

6.6 Thermal stability

Carry out the test according to the air cooling method specified in GB/T 10701-2008. Take three samples with a length of 50 mm±1 mm, a width of 50 mm±1 mm, and a thickness of 5 mm±1 mm, keep them at the temperature of 1200 ℃±10 ℃ for 30 min, take them out and cool them in the air to room temperature.

6.7 Heat resistance

6.7.1 Samples

Take 3 samples; the length is 180 mm±2 mm, the width is 20 mm±1 mm, and the

H_1 -- the arch height of the sample before the test, in millimeters (mm);

H_2 -- the arch height of the sample after the test, in millimeters (mm).

The result is rounded to one decimal place, and the maximum deformation rate among the three samples is taken as the measurement result.

6.8 Thermal conductivity

Clean the sample in an ultrasonic bath, then wipe it with alcohol, rinse it with deionized water, and dry it at 110 ℃±5 ℃ or dry it naturally; carry out the test according to the method specified in GB/T 22588, and round the result to 2 decimal places.

6.9 Content of impurity elements

Carry out the test according to the method specified in GB/T 3284.

6.10 Maximum pore size, pore size standard deviation, porosity, and porosity standard deviation

6.10.1 Samples

Take 3 samples; the length and width are about 50 mm, and the thickness after grinding is 5 mm±0.5 mm. The test surface shall be free from concaves, scratches, cracks, and other defects that affect the test.

6.10.2 Equipment

The requirements for pore analysis equipment:

a) It can measure the smallest pore diameter that is not greater than 0.1 μm;

b) The moving range of the sample platform is not less than ±60 mm, and the smallest moving unit is not greater than 0.002 mm.

6.10.3 Test methods and procedures

The area method is used for measurement, and the test is carried out as follows:

a) Wipe the surface of the sample with alcohol until it is clean, use black ink or a black oil-based pen to blacken the test surface of the sample, and fill the pores of the test surface with white powder (such as limestone, talcum powder) with a particle size of less than 10 μm after the surface dries completely;

b) The equipment needs to be turned on and warmed up for 0.5 h; then, adjust the focal length of the lens to make the phase clear, use the standard ruler to set the conversion ratio between the actual size and the pixel, and set the

appropriate binarization threshold to clearly identify the pores; set the measuring range to be 20 mm×20 mm, the minimum analysis pixel to be 2, the circularity to be 0.3, and each frame of the image to be 5 mm×5 mm, a total of (4×4) frames;

c) Measure the pore diameter and porosity of the three samples, respectively.

6.10.4 Data processing

The data is processed as follows:

a) Take the maximum value of the measured pore diameters of each sample as the maximum pore diameter of the sample;

b) Calculate the standard deviation of the pore diameter of each sample;

c) Calculate the porosity standard deviation of the three samples;

d) The above results are all rounded to one decimal place.

7 Inspection rules

7.1 Inspection classification

It is divided into factory inspection and type inspection.

7.2 Factory inspection

7.2.1 Inspection items

The factory inspection items are specification, dimension, dimensional deviation, and appearance quality.

7.2.2 Sampling

For the specification, dimension, dimensional deviation, and appearance quality, all products need to be 100% inspected.

7.2.3 Judgment rules

If the specifications, dimensions, dimensional deviations, and appearance quality all meet the requirements, the product will pass the factory inspection. If any item fails to meet the requirements, the product is not qualified.

7.3 Type inspection

7.3.1 General rules

7.3.5 Judgment

7.3.5.1 Specifications, dimensions, dimensional deviations, and appearance quality

If the specification, dimension, and dimensional deviation meet the requirements, the specification, dimension, and dimensional deviation of this batch of products are qualified. If the number of unqualified products is greater than or equal to the corresponding rejection limit in Table 2, the specification, dimension, and dimensional deviation of this batch of products are unqualified.

If the appearance quality meets the requirements, the appearance quality of this batch of products is qualified. If the number of unqualified products is greater than or equal to the corresponding rejection limit in Table 2, the appearance quality of this batch of products is unqualified.

7.3.5.2 Density

If the sample meets the requirements, the item is qualified, otherwise it is unqualified.

7.3.5.3 Spectra transmittance

If the sample meets the requirements, the item is qualified, otherwise it is unqualified.

7.3.5.4 Thermal stability

If the three samples meet the requirements, the item is qualified, otherwise it is unqualified.

7.3.5.5 Heat resistance

If the sample meets the requirements, the item is qualified, otherwise it is unqualified.

7.3.5.6 Thermal conductivity

If the sample meets the requirements, the item is qualified, otherwise it is unqualified.

7.3.5.7 Content of impurity elements

If the sample meets the requirements, the item is qualified, otherwise it is unqualified.

7.3.5.8 Maximum pore size, pore size standard deviation, porosity, and porosity standard deviation

If the maximum pore size, pore size standard deviation, porosity, and porosity standard deviation of the sample all meet the requirements, the item is qualified. If one of them does not meet the requirements, the item is unqualified.

7.3.5.9 Comprehensive judgment

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