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NATIONAL STANDARD OF THE PEOPLE'S REPUBLIC OF CHINA

GB/T 14146-2021

Replacing GB/T 14146-2009

Test method for carrier concentration of silicon epitaxial layers - Capacitance-voltage method

硅外延层载流子浓度的测试 电容-电压法

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Foreword

This document is in accordance with the provisions of GB/T 1.1-2020 "Guidelines for Standardization Work Part

1.Structure and Drafting Rules of Standardization Documents" Drafting. This document replaces GB/T 14146-2009 "Silicon Epilayer Carrier Concentration Determination of Mercury Probe Capacitance-Voltage Method", and Compared with GB/T 14146-2009, in addition to structural adjustments and editorial changes, the main technical changes are as follows:

a) The scope of this document has been changed, including the specified content and scope of application (see Chapter 1, Chapter 1 of the.2009 edition);

b) Delete GB/T 1552 in the normative reference documents, and add GB/T 1551, GB/T 6624, GB/T 14264 (see Section

2 Chapter, Chapter 2 of the.2009 edition);

c) Added terms and definitions (see Chapter 3);

d) The requirements of the test conditions are changed (see Chapter 4,

6.2 of the.2009 edition);

e) The formula in the principle of the mercury probe capacitance-voltage method has been deleted, and the expression of the principle has been changed (see 5.1, Chapter 3 of the.2009 edition);

f) Added the interference factors that affect the test results of the mercury probe debugging after sample preparation, test instrument operation, and test machine maintenance (See 5.2.1);

g) The influence of the sample surface, mercury, and mercury capillary on the test results has been changed (see 5.2.2, 5.2.3, 5.2.4,

4.1 in the.2009 edition);

h) Added the influence of the thickness of the standard sample used to determine the compensation capacitor on the test results (see 5.2.7);

i) Added compensation capacitor zero adjustment or value determination, capacitance measurement circuit series resistance, and quality monitoring chip pair test for calibration instruments The impact of results (see 5.2.8, 5.2.9, 5.2.10);

1 Scope

GB/T 14146-2021 is the Chinese national standard on test method for carrier concentration of silicon epitaxial layers - capacitance-voltage method, in the field of metallurgy. The /T suffix marks it as a recommended standard: it is not compulsory by itself, but it becomes binding as soon as a contract, a tender or a customer specification calls it up - which in practice is how most foreign buyers meet it. It was issued on 21 May 2021 by the State Administration for Market Regulation; Standardization Administration of China, and has been in force since 1 December 2021. Classification: ICS 77.040, CCS H21. This page is published from the official record of the standard held by the Chinese standards administration: the identification, the dates, the classification and the issuing body are taken from there. The clause text, the tables and the numeric limits are in the document itself, which is delivered complete in English translation.

This document specifies the capacitance-voltage method to test the carrier concentration of the silicon epitaxial layer, including the mercury probe capacitance-voltage method and the non-contact electrical method. Capacity-voltage method. This document is applicable to the test of the carrier concentration of the homogeneous silicon epitaxial layer, the test range is 4x1013cm-3~8x1016cm-3, of which the silicon The thickness of the epitaxial layer is more than twice the depth of the depletion layer under the test bias. Carrier concentration measurement of silicon single crystal polished wafers and homogeneous silicon carbide epitaxial wafers The test can also refer to this document, where the non-contact capacitance-voltage method is not suitable for the test of carrier concentration of homogeneous silicon carbide epitaxial wafers.

2 Normative references

The contents of the following documents constitute the indispensable clauses of this document through normative references in the text. Among them, dated quotations Only the version corresponding to that date is applicable to this document; for undated reference documents, the latest version (including all amendments) is applicable to This document.

GB/T 1550 Test method for conductivity type of extrinsic semiconductor materials

GB/T 1551 Determination of resistivity of silicon single crystals. Straight back probe method and DC two probe method

GB/T 6624 Visual inspection method for surface quality of polished silicon wafers

GB/T 14264 Terminology of Semiconductor Materials

GB/T 14847 Infrared reflectance measurement method for thickness of lightly doped silicon epitaxial layer on heavily doped substrate

3 Terms and definitions

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

4 Test conditions

4.1 Ambient temperature. 22°C±3°C, temperature fluctuation is less than ±2°C.

4.2 Environmental humidity. 30%~50%.

4.3 The test environment should be equipped with electromagnetic shielding, antistatic device, well-grounded test machine, power frequency power filter device, and no corrosive gas around. Atmosphere and vibration.

5 Mercury probe capacitance-voltage method

5.1 Principle The mercury probe contacts the surface of the sample, forming a Schottky junction. An adjustable bias voltage is applied between the mercury probe and the sample to make the Schottky junction The potential barrier width of phi is expanded in the epitaxial layer, and the carrier concentration of the sample at the expansion width of the barrier can be determined by the barrier capacitance, capacitance and voltage of the Schottky junction The rate of change and the effective contact area between the mercury probe and the sample are calculated.