National Institute of Standards & Technology

Certificate

Standard Reference Material 1521

Set No.

Boron-Doped Silicon Slices for Resistivity Measurements

This Standard Reference Material (SRM) is intended primarily for use as a reference standard by both producers and consumers using the four-probe method of measuring semiconductor resistivity (ASTM Method F-84). SRM 1521 can also be used with contactless (Eddy Current) resistivity measurement equipment. This SRM consists of two slices of silicon with nominal resistivities of 0.1 and 10.0 ohm·centimeters, respectively. Both slices were cut from crystals grown by the Czochralski process with a (100) growth direction at 0.1 ohm·cm and a (111) direction at 10 ohm·cm. Each slice is individually certified for resistivity.

	0.1 Ω·cm	10. Ω·cm
Slice Number	0.1-______	10-______
Thickness	______ mm	______ mm
Diameter	______ mm	______ mm
Measuring Current (nominal)	______ mA	______ mA
Voltage-Current Ratio[1]	______ Ω	______ Ω
Sheet Resistance[2]	______ Ω	______ Ω
Resistivity[3]	______ Ω·cm	______ Ω·cm

[1]Measurement average, corrected to 23 °C for an ideal 1.59 mm (62.5 mil) probe.

[2]Measurement average, corrected for diameter and for temperature to 23 °C.

[3]Measurement average, corrected for diameter and thickness and for temperature to 23 °C.

Specimen preparation and instrument verification were done in accordance with ASTM Method F-84. Resistivity measurements were carried out at the slice centers by the four-probe method, ASTM Method F-84, with the exception that measurement current was chosen to maintain measured specimen voltage between 10 and 12 mV and six independent pairs of voltage and current readings, were used to compute the average resistivity. Due to resistivity nonuniformity of the silicon slices, the certified values are applicable only to the center of the slices.

The experimental error of measurement has been determined at NIST using two operators on each of two instruments; no systematic effect caused by either operator, or instrument, was observed. The measurements further show the 95% confidence interval for the average resistivity of each individual slice, based on 10 replicate measurements, to be less than 1% for each slice.

Gaithersburg, MD 20899
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(Revision of Certificate dated 2-14-85)

William P. Reed, Chief
Standard Reference Materials Program

(over)

The physical preparation was performed by R. Snurr and J.M. Thomas and resistivity testing of these specimens was performed by D. Ricks. Technical coordination and overall direction of the technical activities were performed by J.R. Ehrstein of the NIST Semiconductor Electronics Division.

The support aspects involved in the original preparation, certification, and issuance of this Standard Reference Material were coordinated through the Standard Reference Materials Program by R.W. Seward.

The update of this certificate and issuance of this Standard Reference Material were coordinated through the Standard Reference Materials Program by N.M. Trahey.

An experiment was conducted to test the longer term multilaboratory reproducibility of resistivity measurements using a previously issued SRM which consisted of 0.1 and 10 $\Omega \cdot$cm silicon slices. The experiment, more than a year in duration, involved five laboratories, and seven sets of the silicon resistivity standards, two of which were circulated among the laboratories, and the remaining five were used for stability tests by the individual laboratories[1]. The pooled results indicate that for either resistivity level in the SRM set, there is a 95% probability that the averages of 5 readings taken in two different laboratories will not differ by more than 1.7%. In addition, no detectable drift in the measured resistivity was found through the course of the experiment for any of the resistivity test specimens used. The results of that experiment are expected to apply to this SRM.

[1]Semiconductor Measurement Technology: Progress Report, January 1 to June 30, 1975, W. Murray Bullis, Editor, NBS Special Publication 400-19, pp. 7-9, (April 1976).