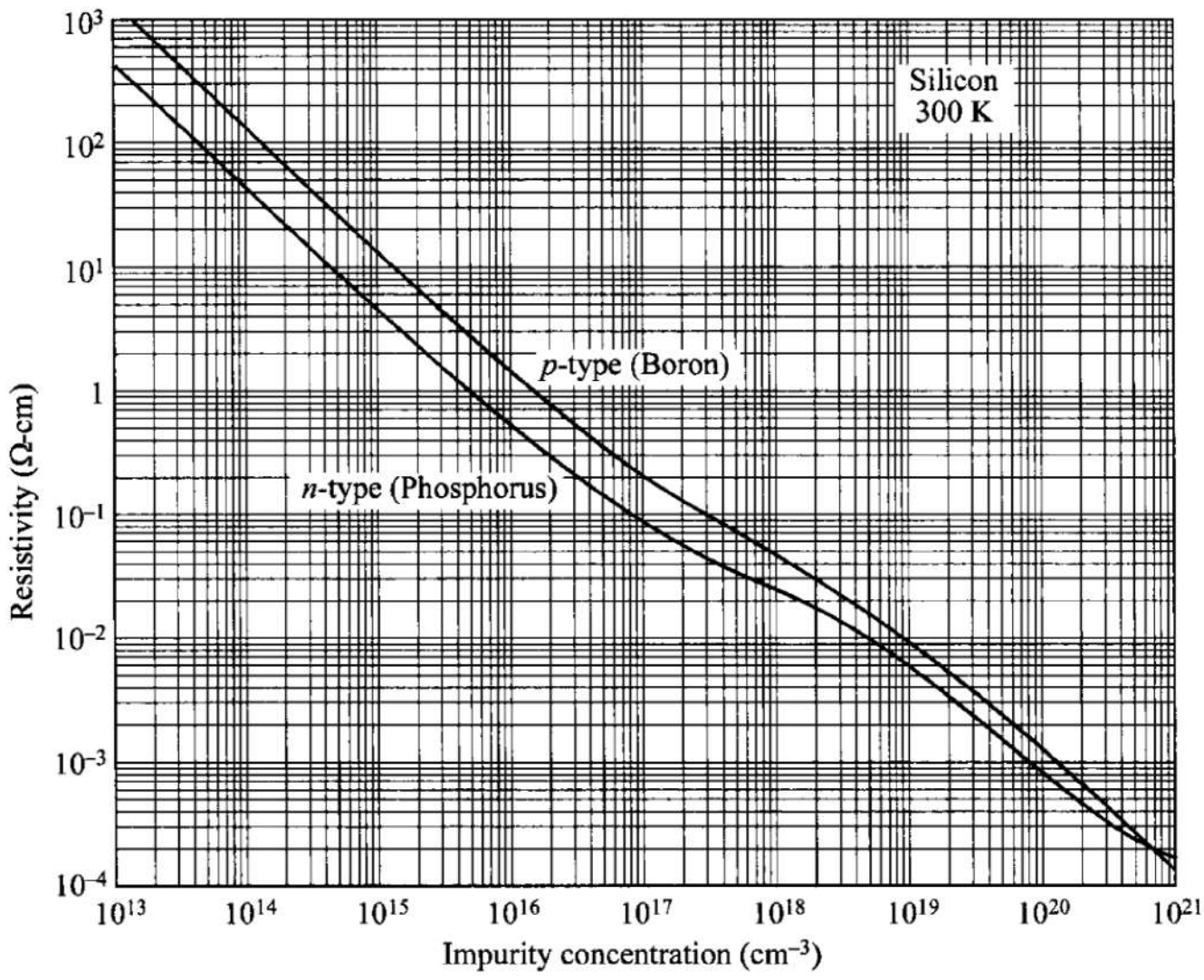
Started on	Monday, 5 August 2024, 10:28 PM
State	Finished
Completed on	Thursday, 8 August 2024, 2:44 PM
Time taken	2 days 16 hours
Marks	4.50/7.00
Grade	**6.43** out of 10.00 (**64.29**%)

Question 1

Correct

Mark 1.00 out of 1.00

While ordering silicon wafers for laboratory experiments, the resistivity of the wafer should be specified. Doping concentration is not specified. However for typical experiments, researchers will require wafers with specific values of doping concentrations. The attached figure shows the resistivity as a function of doping cncentration for phosphorous doped and boron doped silicon at room temperature (source: S. M. Sze, Physics of Semiconductor Devices). Suppose you want to purchase boron doped silicon wafers with doping concentration of $10^{17}cm^{-3}$, what resistivity should you specify in Ohm.cm?



Answer: 0.2 ✓

The correct answer is: 0.2

Question 2

Correct

Mark 1.00 out of 1.00

The specifications of silicon wafers recently purchased in my lab is given in the attached file. Both the specifications and measured values of some of the properties are given. Please note that the decimal seperator used by the supplier is "," as per the EU convention. Find the correct answer to each of the following questions from among the options given.

Specification

Specification name	4" N/Ph (100) 1-5 DSP
Product type	FZ silicon - PV-FZ Wafer
Wafer finish frontside/backside	Double side polished
Wafer orientation	(1-0-0) ± 1 deg.
Diameter (mm)	100,00 ± 0,20
Primary flat	32,5 ± 2,5 mm; Orientation: (1-10) +/- 1 Deg.
Secondary flat	18,0 ± 2,0 mm; Orientation: 180 +/- 5 Deg.
Doping	N-type (Phosphorous)
Resistivity (Ohm-cm)	3,00 ± 2,00
Lifetime (microsec)	> 2000
Thickness (µm)	280,00 ± 20,00
Total Thickness Variation (TTV) (µm)	< 12
Bow (µm)	< 30

Delivered product

Topsil item number	b35-11000-0280-001
Topsil ingot number	32-1725-10

Product analysis

Resistivity [average ± std. dev] (Ohm-cm)	2,65 ± 0,04
Minority carrier lifetime [minimum] (µs)	14501
Thickness [average ± std. dev] (µm)	281,9 ± 1,24
TTV [average ± std. dev] (µm)	4,1 ± 0,42
Bow [average ± std. dev] (µm)	3,5 ± 0,68

Measured minority carrier lifetime in µsec: 14501 ✓

Specified average resisitivity in Ohm.cm: 3 ✓

Measured average resistivity in Ohm.cm: 2.65 ✓

Specified minoriy carrier lifetime in µsec: > 2000 ✓

Your answer is correct.

The correct answer is: Measured minority carrier lifetime in µsec → 14501, Specified average resisitivity in Ohm.cm → 3, Measured average resistivity in Ohm.cm → 2.65, Specified minoriy carrier lifetime in µsec → > 2000

Question 3

Correct

Mark 1.00 out of 1.00

Which of the following statements are correct regarding the application of various grades of silicon?

- a. Poly crytalline silicon obtained by the Siemens process can be used for fabrication of semiconducotr devices.
- b. Metallurgical silicon can be used for fabrication of silicon semiconductor devices.
- c. Silicon obtained by Czochralsky method can be used for fabrication of semiconductor devices. ✓

Your answer is correct.

The correct answer is: Silicon obtained by Czochralsky method can be used for fabrication of semiconductor devices.

Question 4

Partially correct

Mark 0.50 out of 1.00

Which of the following statements are correct regarding the doping concentration along a silicon ingot grown by Czchralski process? Assume that all the silicon ingots mentioned have identical dimentions.

- a. If a continuos Czchlarski process is used, the doping concentration in a gallium doped ingot can be perfectly uniform.
- b. A phosphorous doped silicon ingot will have more uniform concentration than arsenic doped silicon ingot. ✓
- c. A gallium doped silicon ingot will have more uniform concentration than a born doped silicon ingot.

Your answer is partially correct.

You have correctly selected 1.

The correct answers are: A phosphorous doped silicon ingot will have more uniform concentration than arsenic doped silicon ingot. , If a continuos Czchlarski process is used, the doping concentration in a gallium doped ingot can be perfectly uniform.

Question 5

Incorrect

Mark 0.00 out of 1.00

Silicon wafer grown by Cz process with no intentional doping will be

- a. n-type
- b. p-type
- c. neither n-type nor p-type ✗

Your answer is incorrect.

The correct answer is: n-type

Question 6

Correct

Mark 1.00 out of 1.00

For each question, pick the correct pairing

Lower concentration of oxygen is found in — Fz wafers ✓

Higher concentration of carbon is found in — Cz wafers ✓

Your answer is correct.

The correct answer is: Lower concentration of oxygen is found in → Fz wafers, Higher concentration of carbon is found in → Cz wafers

Question 7

Incorrect

Mark 0.00 out of 1.00

What type of defect is generated in silicon as a consequence of high dose hydrogen implantation used for smart cut process that leads to wafer cleavage?

- ☐ a. point defects
- ☐ b. precipitates
- ☐ c. voids
- ☑ d. dislocations ✗
- ☑ e. stacking faults ✗

Your answer is incorrect.

The correct answer is: voids

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