

FEATURES OF CREATING HIGH-SENSITIVITY PHOTODETECTORS BASED ON COMPENSATED SILICON

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Abstract: *The photoelectric properties of highly compensated silicon were studied in the temperature range of 77–270 K. Samples with resistivity of $10^2\text{--}2 \times 10^5 \Omega\cdot\text{cm}$ were obtained using thermal diffusion. The results demonstrate the potential for developing highly sensitive photodetectors for natural white light.*

Keywords: *Highly compensated silicon; photoelectric properties; thermal diffusion; photodetectors; resistivity*

The study of the photoelectric properties of silicon with a maximum concentration of electroactive compensating impurities under conditions of strong compensation is of great scientific and practical interest [1–3].

In this regard, we investigated the photoelectric properties of silicon with a maximum concentration of compensating impurities under strong compensation conditions over a wide temperature range of $T = 77\text{--}270 \text{ K}$. Based on a technology developed in our research laboratory, highly compensated silicon samples were fabricated with resistivity values of $\rho = 10^2\text{--}2 \times 10^5 \Omega\cdot\text{cm}$ (at room temperature, $T = 300 \text{ K}$). As the initial material, industrial monocrystalline silicon of grade KDB-1 was used, where the initial boron concentration was $n(\text{B}) = 2.5 \times 10^{16} \text{ cm}^{-3}$.

Samples of highly compensated silicon with maximum impurity concentrations were obtained using the thermal diffusion method over a wide diffusion temperature range of $T(\text{d}) = 850\text{--}1250 \text{ }^\circ\text{C}$.

Based on the new experimental results obtained, the possibility of creating a new class of highly sensitive photodetectors for white integral natural light has been demonstrated. The main characteristic parameters of these photodetectors are presented in Table 1.

Table 1

Main parameters of photodetectors.

Falling light flux on the working surface of the photodetector $F=0 \text{ Lm}$					
Voltage, V	2	4	6	8	10
Current strength, μA	18,2	36,4	54,4	72,3	90,3
Resistance, $\text{k}\Omega$.	$\approx 109,8$	$\approx 110,2$	$\approx 110,3$	$\approx 110,6$	$\approx 110,7$



The falling light flux on the working surface of the photodetector is $F=0.02$ Lm.					
Voltage, V	2	4	6	8	10
Current strength, μA	110	208,4	312,5	377,6	475,3
Resistance, $\text{k}\Omega$.	$\approx 18,2$	$\approx 19,1$	$\approx 19,3$	$\approx 21,1$	$\approx 21,2$
The falling light flux on the working surface of the photodetector is $F=0.06$ Lm.					
Voltage, V	2	4	6	8	10
Current strength, μA	183,2	360,3	530,9	714,3	901,2
Resistance, $\text{k}\Omega$.	$\approx 10,9$	$\approx 11,1$	$\approx 11,3$	$\approx 11,2$	$\approx 11,1$

It has been established that, unlike existing ones, such photodetectors possess sufficiently high sensitivity over a large temperature range.

Conclusion.

The conducted study confirms that silicon with a high concentration of compensating impurities under strong compensation conditions exhibits significant photoelectric properties over a wide temperature range.

The developed fabrication approach allows obtaining highly compensated silicon with controlled resistivity characteristics.

Experimental results demonstrate the feasibility of using such materials for the development of highly sensitive photodetectors operating in natural white light conditions.

These findings highlight the scientific and practical potential of strongly compensated silicon for advanced optoelectronic applications.

REFERENCES:

1. A.B. Sa'dullaev. Features of complex formation between impurity atoms of manganese and oxygen in silicon. A young scientist. No. 12, 2014, pp. 50-52.
2. Zikrillaev N.F., Sadullaev A.B. Power spectra of impurity in semiconductors in the condition of strong compensation. //SSP-2004. 8-th International Conference SOLED STATE PHYSICS, August 23-26, 2004, Almaty, Kazakhstan Abstracts Almaty-2004, pp-254-255.