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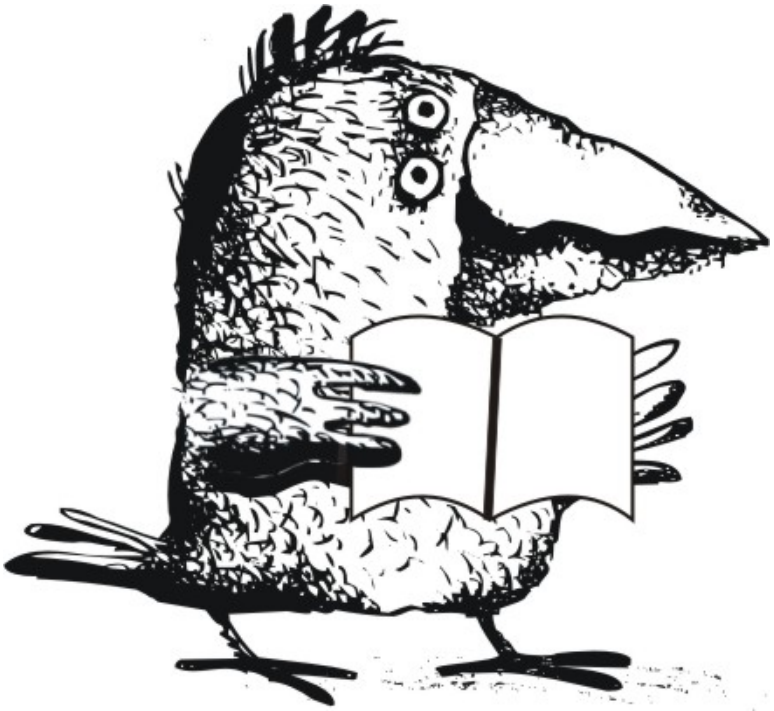

BOOK of ABSTRACTS

8th International School and Conference on Optoelectronics, Photonics, Engineering and Nanostructures

May 25-28, 2021 • Saint Petersburg, Russia

“Saint Petersburg OPEN 2021”

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NATIONAL RESEARCH UNIVERSITY

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Electric, Magnetic and Microwave Devices

Other Aspects of Nanotechnology

Silicon carbide of 4H-SiC type Schottky diode current-voltage characteristics in small-sized type metal-polymeric package SOT-89

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Bryansk State Technical University, Bryansk, 50 let Oktyabrya 7, Russia

Abstract. The forward and reverse current–voltage characteristics of Ti/4H-SiC Schottky diode in small-sized (SOT-89) type metal-polymeric package have been obtained. On the base of analysis it is shown that Schottky diode corresponds to the "ideal" diode with ideality factor $n \approx 1.012$ and effective Schottky barrier height $\varphi_B = 1.23$ eV.

1. Introduction

It is known that the silicon carbide (SiC) Schottky diodes are key component of power semiconductor electronics devices for high-temperature device applications because of its high breakdown voltage, low series resistance and stability under high temperature conditions [1]. Now modern power electronic industry comes down to use of small type of metalpolymeric package such as SOT (Small Outline Transistor), QFN (Quad Flat No-leads) and others [2], but in Russia manufacture of the main electronic components earlier was produced in standard large-sized package (DIP (Dual In-line Package), TO (Transistor Outline) and others) type. Therefore, recently by electronic company the «GROUP KREMNY EL» (Bryansk, Russia) the production of SiC Schottky diodes for power electronics began within the framework of import substitution program. In our previous studies were investigated some characteristics of the SiC Schottky type diodes made in small type of metalpolymeric packages [3]. In this study the main goal is establish current-voltage characteristics of Ti/4H-SiC Schottky diode made in small-sized (SOT-89) type of metalpolymeric package.

2. Materials and methods

In experiments was tested the following Ti/4H-SiC type Schottky diode DDSH411A91 (JSC «GRUPPA KREMNY EL», Bryansk, Russia) in small-sized SOT package type (SOT-89, package dimensions – 4.6×2.6 mm). The parameters of Ti/4H-SiC type Schottky diode were the following: the concentration of donors (nitrogen) in the substrate equals 10^{18} cm^{-3} (thickness of substrate is 300 μm), concentration of donors in the *n*-type epitaxial layer (nitrogen) equals 4.75×10^{15} cm^{-3}, concentration of p+ donors in the guard rings (boron, depth of guard about 2 μm) regions 10^{18} cm^{-3}, the guard p+ rings consist from one of big guard ring with width of 30 μm and five small guard rings with width of 5 μm (the distance between guard rings was 5 μm), JTE (Junction Terminate Extension) layer formed by boron implantation with p+ concentration 4.75×10^{17} cm^{-3} (extending 30 μm beyond the edge of the last p+ guard ring), anode material is Ti (titanium), the thickness of the epitaxial layer (4H-SiC) was 14 μm, the radius of the diode equals r=680 μm. For measuring the direct and reverse current-voltage characteristic were used a programmable source AKIP 1144-160-40, Tektronix MDO3102 two-channel oscillograph (bandwidth 1 GHz, refresh rate 5 GS/s) and Fluke 8845A digital multimeter.

3. Results and discussion

In Figure 1 is shown the forward current-voltage characteristic for DDSH411A91 Schottky diode in small-sized SOT-89 type package obtained at temperature of 25°C. Further, in Figure 2 presents the reverse current-voltage characteristics for DDSH411A91 Schottky diode (25°C). As follows from current-voltage characteristic the fabricated DDSH411A91 Schottky diode in small-sized package operate with forward current up to 2 A and breakdown voltage 1200 V in reverse direction mode.

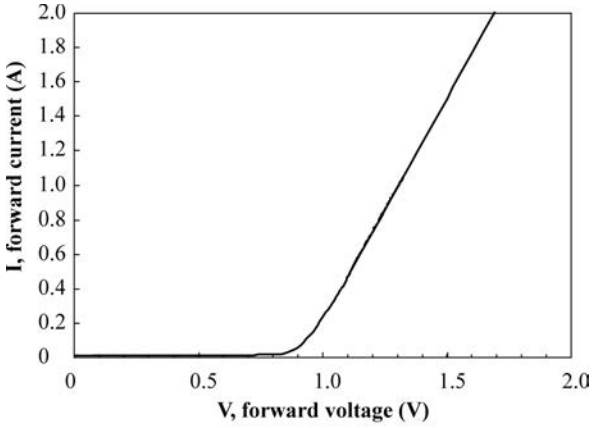

Figure 1. Ti/4H-SiC Schottky diode DDSH411A91 in small-sized SOT-89 type package forward current-voltage characteristic.

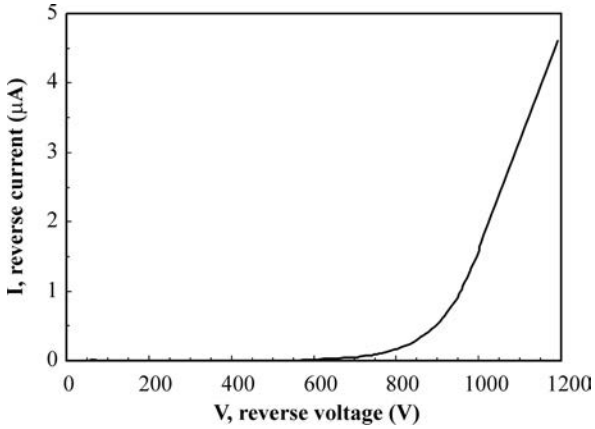

Figure 2. Ti/4H-SiC Schottky diode DDSH411A91 in small-sized SOT-89 type package reverse current-voltage characteristics.

Analysis of experimental results in framework of classical diode theory [1,4] shows that ideality factor of DDSH411A91 diode equal 1.012 and effective Schottky barrier height φ_B=1.23 eV.

4. Conclusions.

Forward and reverse current-voltage characteristic for DDSH411A91 (Ti/4H-SiC) Schottky type diode in small-sized SOT-89 metalpolymeric package were obtained. It is shown that fabricated Ti/4H-SiC Schottky diode demonstrate current up to 2 A in forward direction and breakdown voltage 1200 V. It is established that ideality factor of diode is 1.012 and effective Schottky barrier height φ_B=1.23 eV.

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