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ABSTRACTS

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I-V Characteristics simulation of silicon carbide Ti/4H-SiC Schottky diode

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Silicon carbide of 4H-SiC type represents an excellent candidate for high-temperature power electronic device applications because of its high breakdown voltage, low series resistance, and stability under harsh chemical and high temperature conditions [1]. In particular, 4H-SiC Schottky diodes for power electronics in future must be produced by domestic company the «GROUP KREMNY L» (Bryansk). It is obviously that for development of component base on the base of SiC studying and optimisation of such important device as Schottky diode it is necessary. Therefore in this work simulation of current-voltage (*I-V*) characteristics in 4H-SiC Schottky diode with Ti Schottky contact with used of TCAD program has been carried out. The parameters for simulation were following: the concentration of donors (nitrogen) in the substrate equals 10^{18}, in the epitaxial layer equals 8×10^{15}, anode material is Ti (titanium), thickness of the epitaxial layer (4H-SiC) is 15 μm, radius of the structure is 200 μm. For simulation model of current-voltage characteristics has been solved electrostatic Poisson's equation in cylindrical coordinates together with continuity equations for electrons and holes. Forward (a) and reverse (b) current-voltage characteristics of Ti/4H-SiC Schottky diode are presented in Fig. 1. On the base of thermionic emission theory it is established that forward current-voltage characteristics (Fig. 1a) in terms of the proposed the simulation model of Schottky diode corresponds to the almost "ideal" diode with effective Schottky barrier height φ_B = 1.17 eV with average ideality factor of Schottky diode n = 1.09. Above-mentioned parameters are very good agreements with experimental data for such type of silicon carbide Schottky diode [1, 2]. From reverse current voltage simulation follows that the breakdown voltage for Ti/4H-SiC Schottky diode equals ~2 kV (see Fig. 1b).

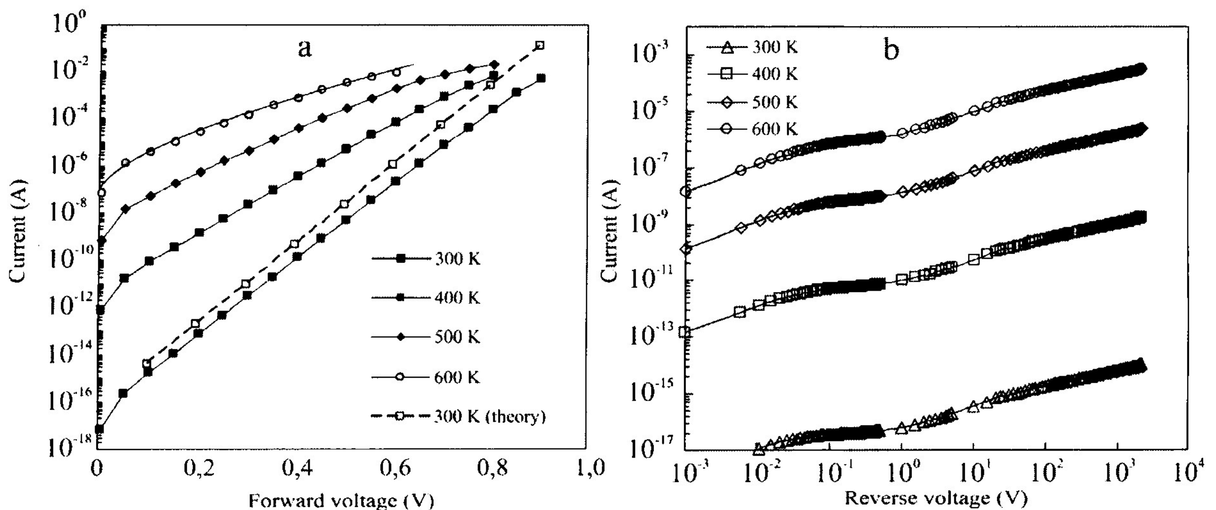

Fig. 1. Ti/4H-SiC Schottky diode forward (a) and reverse (b) *I-V* characteristics.

Theoretical value of breakdown voltage calculated for Ti/4H-SiC Schottky diode is 1.875 kV that is in close agreement with simulation reverse current-voltage data (~2 kV). Finally, forward and reverse current-voltage characteristics of 4H-SiC Schottky diode with Ti Schottky contact have been obtained on the base of simulation model in TCAD in framework of the physical analytical models based on Poisson's equation, drift–diffusion and continuity equations. In addition, on the base of thermionic emission theory have been calculated important parameters (ideality coefficient, effective Schottky barrier height, breakdown voltage) for Ti/4H-SiC Schottky diode. Authors would like to thank Dr. Surin B.P. for help in carrying out of TCAD simulation. This work was supported by the Russian Ministry of Education (Grant No. 02.G25.31.0201).

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