PROPERTIES OF 6H SiC/CdS HETEROJUNCTIONS

M. Duisenbaev
Karakalpak State University, 1 Abdirov St, Nukus, Karakalpakstan, Uzbekistan, Tel: (998 61) 223-60-24(Office), (998 61) 223-05-66 (Home), Fax: (998 61) 223-57-36, E-mail: Duisenbaev_b@mail.ru

Single crystalline silicon carbide is one of the most perspective and valuable material of micro and optoelectronics, which can operate at extreme conditions and modes. It is used for preparation of the devices on wideband gap semiconductors such as GaN and AlN. From the point of view studies of contacts between SiC and other semiconductor presents much interest.

Previously we studied photoelectric properties of 6H n-SiC/n-CdS heterojunction (Ref.[1]) and found current-voltage and capacity-voltage characteristics in forward direction of type I~exp(U) and 1/C²~U, respectively. Here U is the dimensionless parameter and C is the capacity. Photosensivity was in range from 0.39 to 0.63 µm. The aim of this work is preparation of 6H n-SiC/n-CdS heterostructures and study of electrical and photoelectric properties.

The heterojunction is received by thermal evaporation in vacuum on 6H n-SiC substrate with orientation [001] Si. (ρ≈0.03-15 Ωm*cm) at speed V=0.5-5 Å/s. Temperature of the substrate and the source were accordingly Tₙ=573-828 K and Tₕ=1123 K. The 6H n-SiC substrates have been treated mechanically and chemically before preparation of the structure. Methods of treatment of 6H n-SiC and getting the Ohmic contacts have been prepared as in Ref.[2]. Indium was used as Ohmic contact for vacuum evaporated CdS.

Results of receiving the heterojunctions at Tₙ=773 K and V=0.5 Å/s. Current-voltage characteristics of investigated structures has shown, that in the field of small voltage, current depend from voltage I~V, i.e. Ohm’s law. After linear section observed square dependence. Next follows I~V³/₂. Reverse branch of current-voltage characteristic has view I~V³/₂.

Volt-farad characteristic were linear in coordinates 1/C² ~U. However at 1/C² ~U and in interval of voltage 0.5-3V dependence have a staircase view. The contact difference of potentials determined by dependence of extrapolation 1/C² =0 was equal ~0.3-0.4V.

On spectrums of short circuit current observed peaks at E=2.5 eV and at E=2.97 eV. In interval 2.7<h <2.9 eV thin structure was observed.

Growth of 6H n-SiC/n-CdS heterojunctions at conditions Tₙ=773 K and V=0.5 Å/s. Grown layer have high resistance. Observed by us I~V, I~V³/₂, probably bonded with space-charge-limited currents. In this case probably in at contact layer CdS, create a high concentration of electrons, which provides high density of space-charge-limited currents. Expression for inverse branch of
current-voltage characteristic received by authors:

$$I = \frac{\sqrt{2}}{\varepsilon m} \frac{e^{\phi_1}}{1/2} \left( \phi + \phi_k \right)^{3/2}$$

(1)

Where $\phi_1$ ($\phi_{SiC}$-$\phi_{CdS}$) - difference of electronic offinite SiC and CdS. Determined by inverse current-voltage characteristic $\phi_1=0.45$ eV. This result not contradict results of work [4] $\phi_{SiC}=4.1$eV and $\phi_{CdS}=4.8$eV i.e. $\phi_1<0$

In this case in CdS appears as a quantum well, serving as energy trap for the conductivity electrons. Plateau on the CV characteristics is related to screening of the external electric field with electrons in the quantum well. The screening is stopped at devastating of the quantum well and capacitance change with skip. Observed by us thin structure at 2.7eV<hv<2.9eV probably boned with dimensional quantization.

In summary, electrical and optoelectronic properties of 6H n-SiC/n-CdS heterojunctions have been investigated. It is shown at contact layer CdS create high concentration of electrons which provides high density of space-charge-limited currents. Thin structure probably bonded with dimensional quantization, which is confirmed by CV characteristics.

REFERENCES