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Temperature characteristics of Ni/4H-SiC Schottky barrier diode for alpha particles detection

Content

Schottky barrier diode (SBD) radiation detectors were prepared using 20μm thick n-type 4H-SiC epitaxial layers for α particles detection. The SBD was fabricated by depositing Ni on Si face forming Schottky contacts and Ni/Au ohmic contact on C face, respectively. The forward and reverse current-voltage (I-V) characteristics, over a wide temperature range 298-423K, were carried out on the Ni/4H-SiC SBD detector. The reverse I-V characteristics of detector shows almost unchanged leakage current in the temperature range 298-398K, revealing a possibility of high temperature operation. The forward I-V analysis of detector based on thermionic emission (TE) theory indicates an increase of the barrier height and a decrease of the ideality factor with the temperature increasing, which can be attributed to barrier height inhomogeneities at the metal/semiconductor interface. The effective barrier height value of 1.544eV obtained from the forward I-V-T data, matches very with the barrier height of 1.553eV from capacitance-voltage (C-V) measurement, while the Richardson constant value of 6.899Acm-2K-2 is much lower than theoretical value of 146Acm-2K-2, which can be explained by assuming a Gaussian distribution of the Schottky barrier height. The mean barrier height of 1.729eV and the standard deviation of 74.330mV are obtained from the plot of apparent barrier height versus q/2kT. Through the modified Richardson plot, the mean barrier height is found to be 1.728eV, which is good in line with the one calculated from apparent barrier height Gaussian distribution, while the Richardson constant is calculated as 141.383Acm-2K-2, which is much closer to the theoretical value. Key Words: 4H-SiC, Schottky diode, thermionic emission, temperature, Richardson constant

Summary

This papar is mainly about temperature characteristics of Ni/4H-SiC Schottky barrier diode for alpha particles detection. The reverse I-V characteristics of detector reveals a possibility of high temperature operation. The forward I-V analysis indicates an increase of the barrier height and a decrease of the ideality factor with the temperature increasing, which can be attributed to barrier height inhomogeneities at the metal/semiconductor interface.

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