Fabrication of thermostable Pt/Ti Schottky rectifier to n-type 4H silicon carbide

N.I. Cho [a,*], Y. Choi [b], C.K. Kim [c]

[a]*Department of Electronic Engineering, Sunmoon University, Korea.*

[b]*Department of Metallrugical Engineering, Sunmoon University, Korea.*

[c]*Department of Electrical Engineering, Soonchunhyang University, Korea.*

Silicon carbide (SiC) Schottky rectifiers are promising technology for high power and microwave device applications operating at high temperatures. They offer the potential for a low forward voltage drop, high breakdown voltage, and fast switching speed with no reverse recovery current. In this study, Schottky barrier rectifiers were fabricated by using SiC substrates. The SiC Schottky contacts were made by an evaporation of metals with a contact structure of oxide edge termination. SiC wafers with a 10 micrometer thickness lightly doped n-type epitaxial layer grown on highly doped n-type Si-face 4H-SiC substrates were utilized to fabricate the Schottky rectifiers. The 4H-SiC has been known to have a largest bandgap and highest electron mobility among various polytypes of SiC. Different metals of Pt, Ti, Ni were employed for the Schottky contacts, whereas Ni was used for the ohmic contact on the back side of the SiC wafer. The metal contacts were annealed at 800°C for 2 minutes immediately after the metal evaporation. Material and electrical properties of the Schottky rectifiers were characterized along the temperature ranges up to 300°C. Electrical parameters of the rectifiers were obtained by measuring electrical current-voltage (I-V) curves and capacitance-voltage (C-V) hysteresis loops. Thermally stable characteristics were obtained for the Ti-based contact with double later scheme of Pt/Ti. The Schottky barrier height (SBH) for the Pt/Ti contact determined from the I-V and C-V measurements was calculated to be 1.24 eV. The ideality factor of the Pt/Ti rectifier was estimated as low as 1.08. The values of the SBH and the ideality factor were maintained after the prolonged heating at constant temperature of 600°C and operating temperatures until 300°C. The interface of Ti and SiC was turned out to be chemically stable in the analysis of X-ray photoelectric spectroscopy, which is important for the stable operation at high temperatures. The top Pt layer was analyzed to play a role as a protection layer from the oxidation of Ti layer during the device operation at high temperatures.

---

* Corresponding author.
Email address: nicho@sunmoon.ac.kr (N.I. Cho).