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ホール測定による高 Al 濃度 4H-SiC 厚膜の電気特性評価

Hall-effect measurement on the electrical properties of heavily Al-doped 4H-SiC thick epilayer

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The polytype of silicon carbide (SiC), 4H-SiC, is thought very promising in the application fields of high power devices. However, it suffers from the lack of the low resistivity p-type 4H-SiC wafer (~15 mΩ·cm). In the previous paper [1], we reported the growth of heavily Al-doped 4H-SiC thick epilayers (~90 μm) by HW-CVD with low resistivity of 16.5 mΩ·cm and Al doping level up to N_{Al}=3.5×10^{20} cm^{-3}. It is thought being capable of filling the lack of low resistivity p-type 4H-SiC bulk wafer. In this work, to study the electrical properties, temperature dependent Hall-effect measurement was carried out in the range of 20-800 K on thick epilayers with Al doping level from N_{Al}=1.5 to 3.5×10^{20} cm^{-3}, where they were cut to 10×10 mm^2 in size and formed with Al/Ti/Al contacts in van der Pauw configuration.

Figure 1 shows the temperature dependences of the resistivity of two thick epilayers. It reveals steadily decreases of resistivity and finally they become saturate at high temperatures near 800 K. Comparison with the epilayer of N_{Al}=1.5×10^{20} cm^{-3}, the epilayer of N_{Al}=3.5×10^{20} cm^{-3} exhibits a mild change with temperature. Besides, no metallic behavior can be seen even at N_{Al}=3.5×10^{20} cm^{-3}[2]. Figure 2 shows the temperature dependences of carrier concentration. The figure demonstrates the carrier concentration increases with the temperature. From linear fitting at T<100 K, the activation energies of 42 and 10 meV for N_{Al}=1.5 and 3.5×10^{20} cm^{-3} were obtained, respectively. The results seem following the predicted trend of ionization energy of Al-doped 4H-SiC [3], even at Al heavy doping level up to N_{Al}= 3.5×10^{20} cm^{-3}. Detailed characterizations and results will be presented at the meeting.

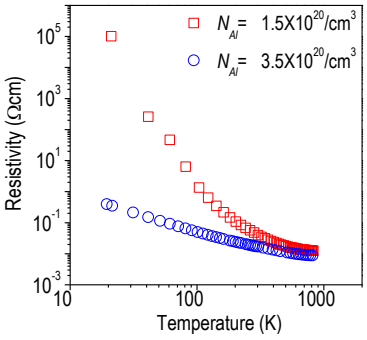

Fig.1　Temperature dependences of resistivity of 90μm thick epilayers.

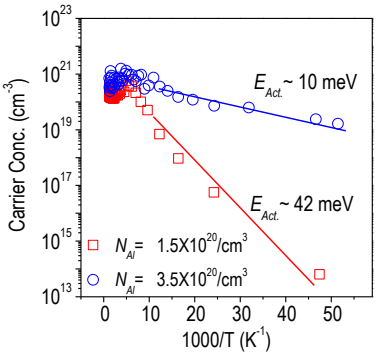

Fig.2　Temperature dependences of carrier density of 90μm thick epilayers

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