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Investigation for Ohmic contact formation in Cr/Au contact to Nonpolar a-plane n-GaN Grown on r-plane

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We have investigated the electrical performances of Cr/Au(50/150nm) contacts to nonpolar a-plane n-GaN. It is known that the surface of non-polar a-plane GaN is different from that of conventional c-plane GaN. This difference in crystal orientation and surface morphology has an effect on the device characteristics, especially Ohmic & Schottky contact properties. Cr/Au films were superior to the bilayer(Ti/Au) and multiplayer (Ti/Pt/Au) in Ohmic contact characteristics.

The contact resistances were measured and calculated by circular transmission line method (CTLM). The as-deposited Cr/Au showed Ohmic behavior with linear I-V relationship, and it transformed to schottky contacts with increasing annealing temperature above 300°C.
Cr/Au Ohmic contact structures were rapid thermal annealed in N_2 for 1min at temperatures in the range 300–800°C. However, the best Cr/Au Ohmic contacts were achieved as-deposited with the best specific contact resistance of $8.82X10^{-4}$ Ωcm^2 and the sheet resistance of 248 Ω/sq. The as-deposited Cr/Au showed Ohmic behavior with linear I-V relationship, and it transformed to schottky contacts with increasing annealing temperature above 300 °C. It is believed that the degradation of contact resistance above 300°C is due to the formation of interfacial layers at the interface between Cr and GaN. In addition, the thermal stability could be improved by inserting a Ni, Pt layer between the Cr and Au layers. This scheme could prevent the diffusion of Au into the Cr layer, thus preventing Au from indiffusion the Cr/GaN interface where it could possibly forming a Ga-Au phase, which would reduce the Ohmic contacts.

The degradation mechanism of Ohmic contact increasing the annealling temperature is carefully investigated with Auger, TEM and other characterization methods.