

# GaN 基板上 AlGaIn/GaN HEMT の低抵抗オーミック電極作製

## Low resistance ohmic contact on AlGaIn/GaN heterostructures grown on GaN substrate

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**[Introduction]** High density 2DEG at AlGaIn/GaN interface and large energy band gap in GaN enable HEMTs with these materials for high power and high frequency applications. Achieving an ohmic contact with low resistance is a key factor to benefit from AlGaIn/GaN structure in HEMTs [1]. Al/Ti-based structures are regarded as the standard ohmic contacts for AlGaIn/GaN due to formation of TiN spikes which penetrate through AlGaIn layer at the threading dislocations within GaN [2]. Therefore, it is assumed that using these contacts on AlGaIn/GaN structures with lower number of threading dislocations, would lead to higher contact resistance. In this work, the ohmic contact properties of Au/Mo/Al/Ti contacts on AlGaIn/GaN heterostructures epitaxially grown on a free-standing GaN substrate are investigated.

**[Experiment]** Fig. 1 shows the schematic layer structure of devices. AlGaIn/GaN layers were grown by MOCVD. Metal contacts were formed by EB evaporation and lift-off method. Similar contacts were also fabricated on AlGaIn/GaN grown on (111) Si substrates (GaN-on-Si). Contact resistivity was evaluated by TLM measurements.

**[Results]** Fig. 2 shows the contact resistivity dependence on annealing temperature for Au/Mo/Al/Ti contacts on both GaN-on-GaN and GaN-on-Si substrates. It is found that ohmic behavior can be obtained from annealing temperatures higher than 700 °C on both substrates. Although GaN-on-Si substrates have  $10^3$  more threading dislocations than GaN-on-GaN substrates, contact resistivity ( $\rho_c$ ) as low as  $4.5 \times 10^{-6} \Omega \cdot \text{cm}^2$  at 900 °C is achieved on both substrates. This is contrary to the common point of view that higher amount of threading dislocations should improve ohmic contact properties [2]. Our results suggest that other mechanisms independent of threading dislocations should be considered for designing contacts with low resistivity on high quality AlGaIn/GaN heterostructures.

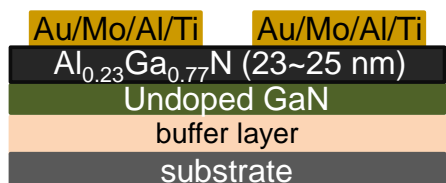


Fig. 1 Schematic of the measured devices.

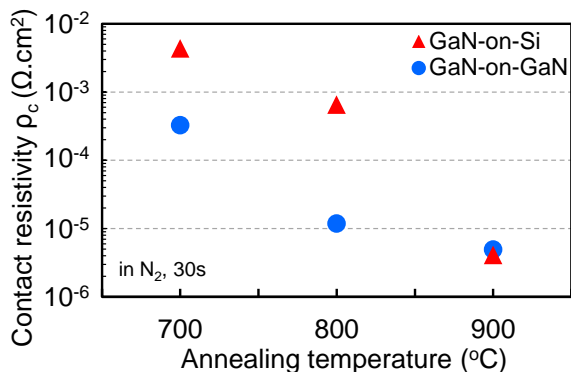


Fig. 2 Contact resistance dependence of Au/Mo/Al/Ti contacts on annealing temperature.

[1] U. K. Mishra, *et al.* Proc. IEEE **96**, 287 (2008).

[2] F. M. Mohammed, *et al.* JVSTB **23**, 2330 (2005).