

## The Effect of Titanium Silicide on AuTi/GaN Ohmic Contact System.

**Cha Yeon Kim, Sung-Woo Kim, Bea-Yong Kim, Yoon-Ho Choi, and Chang-Hee Hong**  
*LG Corporate Institute of Technology,*  
*16 Woomyeon-Dong, Seocho-Gu, 137-140 Seoul, Korea*

**Dae-Woo Kim\*, Hong-Koo Baik\*, and Chung Nam Whang\*\***  
*Yonsei University, Department of Metallurgy\* and Department of Physics\*\**  
*134 Shinchon-Dong, Seodaemoon-Gu, 120-749 Seoul, Korea*

For the development of low resistance ohmic contacts to GaN, we fabricated several metal contact systems (Ti-150 Å/Si-500 Å/Au-1000 Å/, Ti/Si-500 Å/Ti-400 Å/Au/, and Ti/Si-1470 Å/Ti/Au/GaN). In the comparison with GaAs case, GaN based LDs have a few difficulties for the applications: large lattice mismatch with substrates, high defect density, relatively high resistance and thermally unstable ohmic contact, valence band offset on p-type, and so on.

In this paper, we focused on investigating the behavior of  $\text{TiSi}_x$  and the correlation between electrical property and phase formation as a function of annealing temperature for understanding of the metallurgy of metal/GaN contact. Metal shadow mask was used for I-V measurement to evaluate the ohmic characteristic. Contact resistance was evaluated using the transmission line method. In order to obtain the required current path, mesas were etched by reactive ion etching (RIE). TLM pattern was prepared by standard metal lift-off techniques and photolithography.

I-V curves show all contacts were ohmic characteristic after above 700 °C annealing as shown in Fig. 1. XRD and AES profiles present that titanium silicide ( $\text{TiSi}_x$ ) was formed at metal/GaN interface regardless of the thickness of Si layer. In the case of Ti/Si-500 Å/Au/GaN system, only small portion of Si combined with Ti to form  $\text{TiSi}_6$  at the metal/GaN interface and most of Si was widely distributed at Au layer.  $\text{Au}_4\text{Ti}$  phase was detected at low temperature range from 400 °C to 500 °C. On the other hand, the Au/Ti/Si-1470 Å/Ti/GaN system with three times thick Si layer shows  $\text{TiSi}_2$  layer is formed beneath Au layer without regard to the temperature range. As temperature increase from 500 °C to 700 °C,  $\text{TiSi}_2$  phases were transformed from C54 to C49 phase with lower resistance. Minimum work function of  $\text{TiSi}_2$  was reported as 3.59 eV in case of C54 phase.

Finally it was found that the formation of  $\text{TiSi}_2$  controlled the flux of indiffusing Au element, and that played an important role of making low barrier ohmic contact due to the low work function of  $\text{TiSi}_2$ .

The fact that good ohmic contacts were often obtained if Au flux was well controlled have reported by many research group. Compared to our results of the simple AuTi/GaN system, that was clearly explained.

### REFERENCE

- 1) H. Morcok et al., *Appl. Phys. Lett.* 64(8), 1994. & 68(12), 1996.