The Cu-based Ohmic Contact and its Material Analysis of GaN Devices

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Experimental Sections

- Wafer clean
- Mesa lithography
- ICP etch (Ar/Cl₂)
- Ohmic lithography
- Metal deposition
- Lift-off process
- Heat treatment by RTA

- Ti/Al/Ni/Au (200/1200/250/1000) Å
- Ti/Al/Ni/Cu (200/1200/250/1000) Å
- Ti/Al/Ni/Cu (200/1200/50/1000) Å
DC Measurement
Atomic force microscope

After RTP:

<table>
<thead>
<tr>
<th>Material</th>
<th>rms Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ti/Al/Ni/Au</td>
<td>~134nm</td>
</tr>
<tr>
<td>Ti/Al/Ni(50 Å)/Cu</td>
<td>~7.62nm</td>
</tr>
<tr>
<td>Ti/Al/Ni(250 Å)/Cu</td>
<td>~12.5nm</td>
</tr>
</tbody>
</table>

Ti/Al/Ni(50 Å)/Cu after RTP has lower surface roughness.

1. Good surface morphology
2. Good line edge definition
Auger depth profile

Before RTA:

- Each point is measured after 50sec sputter etch with Ar ion.

After RTA(900°C-30sec):

- There’s no Cu diffused into the AlGaN layer.
X-ray diffraction

<table>
<thead>
<tr>
<th>Alloy</th>
<th>2θ/θ Degree(main)</th>
<th>2θ/θ Degree(second)</th>
<th>2θ/θ Degree (other)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al$_4$Cu$_9$</td>
<td>44.106</td>
<td>81.13</td>
<td>77.47</td>
</tr>
<tr>
<td>Al$<em>3.892$Cu$</em>{6.108}$</td>
<td>44.27</td>
<td>81.403</td>
<td>64.26</td>
</tr>
</tbody>
</table>

-Jcpdfwin software data
The Cu diffusion was interfered by the $\text{Al}_3\text{Ti}$. Furthermore, there's no Cu diffused into the AlGaN layer. — *Materials Chemistry and Physics*, vol. 41, pp. 199-205, 1995.

### Conclusion

- A low specific contact resistance of $1.67 \times 10^{-6} \ \Omega\cdot\text{cm}^2$ with optimized Ti/Al/Ni(50Å)/Cu metallization has been fabricated.
- The smooth surface with 7.62 nm rms roughness has been reached on sample with thinner Ni layer(50Å).
  
  The Cu-based ohmic contact is promising for GaN devices and need to be further investigated.