A Cu-based alloyed ohmic contact system on multi-junction solar cell

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Copper has been widely used in metallization for the silicon based very-large scale integration because of its lower electrical resistivity, higher electromigration resistance, and lower cost. However, there are only a few reports on the copper metallization of GaAs devices. In previous studies, some applications of the copper metallization in metal semiconductor field-effect transistors, high electron mobility transistors and have been reported but not for III-V solar cell.

In this study, a low contact resistivity Pd/Ge/Cu ohmic contact to n-type GaAs has been successfully developed. The Cu-metallized three junctions solar cell using Pd/Ge/Cu ohmic contact to n-type GaAs capping layer also has been successfully fabricated.

The Pd (150 Ǻ)/Ge (1500 Ǻ)/Cu (1500 Ǻ) ohmic contact exhibits a very low contact resistivity of $4.4 \times 10^{-6} \Omega \cdot \text{cm}^2$ at a low annealing temperature (250°C). The ohmic contact formation mechanisms and microstructure evolution were investigated using x-ray diffraction (XRD), secondary ion mass transmission electron microscopy (TEM) and energy dispersive spectrometer (EDX).

The Ohmic contact behavior was related to the formation of Cu₃Ge and PdGaₓAsᵧ compounds after annealing and the efficiency of Cu-metallized three junction solar cell was about 20%. The results show that the novel Pd/Ge/Cu ohmic contact can be used on Cu-metallized III-V solar cell, and exhibit good device performance.

Fig. 1 Structure of III-V solar cell with Pd/Ge/Cu n-type ohmic contact

<table>
<thead>
<tr>
<th>Process flow:</th>
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| 1. Back side ohmic contact  
Ti/Pt/Au-50nm/60nm/250nm  
RTA 350°C |
| 2. Front side ohmic contact  
Pd/Ge/Cu-15nm/150nm/150nm  
RTA 250°C |
| 3. AR coating  
PECVD:Si3N4~75nm |

Table 1 The annealing condition of Pd/Ge/Cu and Au/Ge/Ni/Au

<table>
<thead>
<tr>
<th>Metal</th>
<th>Pd/Ge/Cu</th>
<th>Au/Ge/Ni/Au</th>
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<tbody>
<tr>
<td>Annealing temp(°C)</td>
<td>250</td>
<td>320</td>
</tr>
<tr>
<td>$\rho_{c} (\Omega \cdot \text{cm}^2)$</td>
<td>$4.4 \times 10^{-6}$</td>
<td>$1.4 \times 10^{-6}$</td>
</tr>
<tr>
<td>$r^2$</td>
<td>0.996</td>
<td>0.997</td>
</tr>
</tbody>
</table>

Reference