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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.[1–3] However, there are only a few reports on the copper metallization of GaAs devices.[4,5] 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..[6]

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 Å)/Ge (1500 Å)/Cu (1500 Å) ohmic contact exhibits a very low contact resistivity of 4.4 x 10^{-6} Ω-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 Cu_3Ge and $PdGa_xAs_y$ 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.

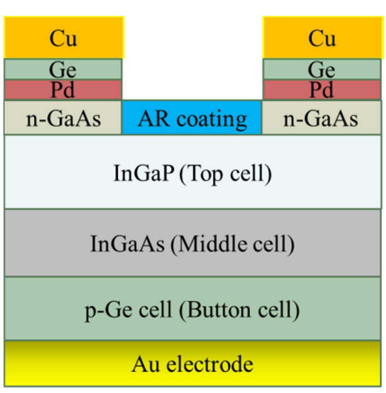

Fig. 1 Structure of III-V solar cell with Pd/Ge/Cu n-type ohmic contact

Process flow:
1.Back side ohmic contact
Ti/Pt/Au-50nm/60nm/250nm
RTA 350℃
2.Front side ohmic contact
Pd/Ge/Cu-15nm/150nm/150nm
RTA 250℃
3.AR coating
PECVD:Si3N4~75nm

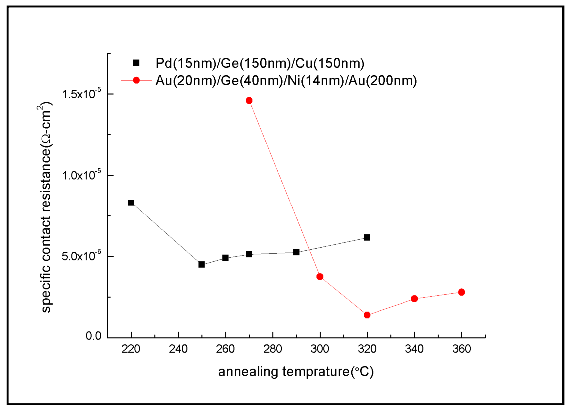

Fig. 2 The TLM measurement of tradition ohmic contact Au/Ge/Ni/Au and Pd/Ge/Cu

The best annealing condition		
Metal	Pd/Ge/Cu	Au/Ge/NiAu
Annealing temp(℃)	250	320
ρ_c $(\Omega - cm^2)$	4.4x10^{-6}	1.4x10^{-6}
r^2	0.996	0.997

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

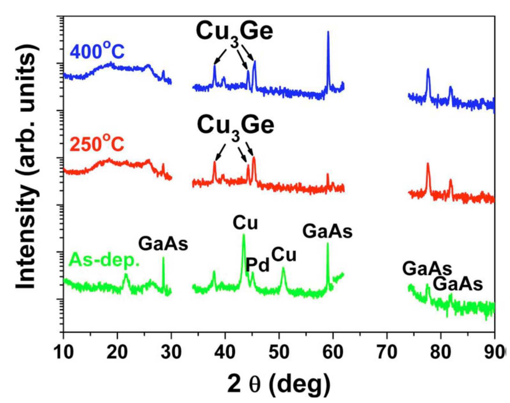

Fig. 3 X-ray diffraction patterns for the Pd (15 nm) /Ge(150 nm) /Cu(150 nm) Ohmic contact structure as deposited and after annealingat 250 and 400 °C for 20 min.

Reference
1. K. Holloway and P. M. Fryer, Appl. Phys. Lett. **57**, 1736 (1990).
2. K. Holloway, P. M. Fryer, C. Cabral, Jr., J. M. E. Harper, P. J. Bailey, and K. H. Kelleher, J. Appl. Phys. **71**, 5433 (1992).
3. D. S. Yoon, H. K. Baik, and S. M. Lee, J. Appl. Phys. **83**, 8074 (1998).
4. C. Y. Chen, L. Chang, E. Y. Chang, S. H. Chen, and D. F. Chang, Appl.Phys. Lett. **77**, 3367 (2000).
5. C. Y. Chen, E. Y. Chang, L. Chang, and S. H. Chen, Electron Lett. **36**,1318 (2000).
6. C. Y. Chen, E. Y. Chang, L. Chang, and S. H. Chen, IEEE Trans. Electron Devices **48**, 1033 (2001).