CHAPTER VIII

CONCLUSION

(1) Au/p-$CuInSe_2$ and Ni/p-$CuInSe_2$ form Schottky barriers between metal and semiconductor. The existence of the barrier in these contacts were measured by the DACCT. The technique needs no pre-established ohmic contact and is effective for a smalll barrier.

(2) Similar to the metal-semiconductor contact, a metal-thin insulator-semiconductor (MIS) contacts behavior can be described by the pseudo-Richardson model. The model assumed that the contact can be represented by an effective barrier B_{eff} and effective area A_{eff}. The current that the barrier can supply under virtually zero bias is governed by pseudo-Richardson equation. This model can be used as a criterion, at a given current and temperature, whether the contact can be considered as ohmic contact or not. The criterion is :

"As long as the current demanded is less than Richardson current the contact is ohmic".

When the current needed is greater than Richardson current, one would expect to encounter the barrier effect.

The prominent feature of this criterion is that it does not depend on the bulk geometry and is easily access by the measurement, ie. the DACCT.

(3)Even with our best Au/p-$CuInSe_2$ contact, and for practical value of current density normally used in measurement of the bulk properties, this contact can be regarded as ohmic contact only at moderate temperatures, ie. above 213 K.

This work also shows that, at a low temperature, say near the liquid nitrogen temperature, still there is no reliable method that could make an ohmic contact for p-$CuInSe_2$.

(4) Most of the tunneling component comes from light hole. This can be seen by comparing tunneling effective mass m^+ obtained from fitting with the effective mass values of light and heavy holes of p-$CuInSe_2$. The tunneling effective mass m^+ is closer to that of the light hole effective mass than that of the heavy holes.

(5) The barrier height ϕ, not including image force lowering, of Au/p-$CuInSe_2$ are in the range 0.3608-0.5680 eV.

(6) The best contacts of Au /p-$CuInSe_2$ could yield contact resistivity values not lower than about 10^{-3} Ω-cm^2, at room temperature. This should be considered as the lower limit for the producible ohmic contacts on p-$CuInSe_2$ today.

(7) The presence of Au could effect a decrease in doping concentration near the interface in some p-$CuInSe_2$ substrates. The doping appears to decrease more as the distance is farther from the interface.

(8) Mo/p-$CuInSe_2$ contacts, because they were prepared by Mo sputtering, may have type conversion in the region that Mo released its kinetic energy; the contacts behave in a manner indicative of a homojunction.

(9) Some Ni/p-$CuInSe_2$ contacts show the peculiar feature in the DACCT measurement. There are somes ranges of the current and temperature such that, at low temperature, the barrier needs smaller applied voltage to sustain the constant current than that needed at a higher temperature. This behavior contradicts the common conduction mechanisms for a Schottky barrier, and should be a subject of future study.