CHAPTER VI
CONCLUSION

GaAlAs/ GaAs/ GaAlAs Double Heterojunction Bipolar Transistors (DHBTs) have been realized by the Liquid Phase Epitaxy (LPE) (Super Cooling Techniques) for both of external base and diffused base structures (i.e. single regrown base, double regrown base and diffuse base). The characterizations of these DHBTs were studied with emphasizing on the DC characteristics. The double heterojunction bipolar transistors with single regrown base and diffuse base exhibited the asymmetrical (I-V) characteristics with lower inverted mode gain due to electron injections in the external base area which mainly loss by recombinations. Even though the wider bandgap P^+-$Ga_{0.8}Al_{0.2}As$ regrown base and diffuse base were used, they can't entirely suppress the electron injection from the external collector base junction. However, the single P^+-$Ga_{0.8}Al_{0.2}As$-regrown base transistors can express higher current gains in the inverted mode compared to the one of p^+-GaAs-regrown base due to their higher barrier for preventing the electron injection from the collector. But, there are two side effects in P^+-$Ga_{0.8}Al_{0.2}As$-regrown base as more recombination centers in the base region and not reliable for base ohmic contact which can degrade the performance of devices.

DHBTs with double regrown base showed the symmetrical (I-V) characteristics with very low offset voltage. This is because the junction between the lower regrown base layer P^+-$Ga_{0.8}Al_{0.2}As$ and N- $Ga_{0.7}Al_{0.3}As$ collector in the external base region can reduce the injection of electrons in inverted mode. Moreover the electron recombinations in the double regrown base are lower than those in the P^+-$Ga_{0.8}Al_{0.2}As$ single regrown base. Therefore the base current is lower leading to the higher current gain in inverted mode. In addition, the offset voltage is other measured parameters for indicating the symmetry of the transistors. It can be evaluated by the difference of CB and EB junction voltages with the third terminal opened and seem to be effected by device parameters or designed structures rather than the ones of materials.