

## Chapter 8

### Conclusions

The  $\text{Al}_{0.58}\text{Ga}_{0.42}\text{As}/\text{GaAs}$  sandwich layers were used to prepare shadow mask on the GaAs substrates. The GaAs layer that placed on the top most acts as mask layer and the  $\text{Al}_{0.58}\text{Ga}_{0.42}\text{As}$  layer underneath as a spacer to hold cantilevers of GaAs mask separately over the substrate about 3  $\mu\text{m}$ .

The 10 MQW mesa structures were then grown through shadow masks onto the GaAs substrates by MBE technology. The structures were self-organized the mesa shapes grown. PL spectra indicate that the mesa structures consist of multiple quantum wells as previous study. PL peaks from the MQW can be tuned by varying of well layer thickness. The sharpness of PL peaks reflects the mesa crystal quality. The PL measurement results showed that improvement of  $\text{As}_4$  flux in the shadow mask is required. However, the experimental results showed stronger peaks from shadow masked mesas and seem that shadow mask technique was suitable for further patternized MQW devices fabrication.

Selective growth epitaxy of GaAs on Si substrates with the shadow mask technique was investigated. The shadow mask for the silicon substrate consists of  $\text{Si}_3\text{N}_4$  as the mask layer and  $\text{SiO}_2$  as the spacer. The effect of growth temperature on mask bending is observed. The growth temperature should not be higher than 450  $^\circ\text{C}$  to avoid any mask bending.

The selective growth epitaxy of GaAs has been carried out also on vicinal Si(100) substrates and the results confirm that a vicinal Si substrate is required for better crystal quality. The size of the epitaxy has an effect on surface morphology. Total number of point defects occur on the epitaxy surface are reduced with smaller sizes of epitaxy. Small epitaxy size has a merit to reduce the effect due to the mismatch of thermal expansion coefficients between GaAs and Si. Growth conditions for selective growing GaAs on Si should be more studied for the optimization. An importance is that the condition of GaAs crystal growth at low substrate temperature (<450  $^\circ\text{C}$ ) could prevent mask bending due to the mismatch of thermal expansion coefficient between GaAs and  $\text{Si}_3\text{N}_4$ .