Chapter 1

Background

1.1 Introduction

Laser diodes have a wide range of interesting applications e.g. optical information processing system, optical communication, optical sensors, and optical fiber gyroscope, etc. Various attractive features of laser diodes include compact size, light weight, low power consumption, low voltage, long life, direct modulation, power tunability, etc. The direct-bandgap compounds of GaAlAs, InGaAsP, and InGaAlP with complete lattice match to high quality binary of GaAs substrate have been investigated as key materials for lasers diodes. Among these materials, the GaAlAs alloy system is the most promising alloy for laser diodes. Becuase the GaAlAs alloy crystal has been extensively studied, developed and utilized for quite some time. Hence, high-quality crystal can be easily grown, ready found and widely spreads in the market compared with other compound semiconductors.

At the present time, the most common growth technology of GaAlAs alloys is liquid phase epitaxy (LPE), molecular beam epitaxy (MBE), and metalorganic chemical vapor deposition (MOCVD). Liquid phase epitaxy is extensively used for the growth of most commercially available GaAlAs devices. Because of the simple equipments, reproducibility and the high-quality crystal easily realized with a low cost system. The growth by LPE is carried out under the thermal equilibrium condition. As the result, most of GaAlAs/GaAs devices in the market are produced by this LPE method.

1.2 Objectives

This work consists of the LPE growth of laser diodes using the GaAs-GaAlAs alloy system, and single quantum well lasers. The goal of this study is very significant because the progressive development on a combined technique of two-phase solution and supercooling techniques for LPE growth of GaAs-GaAlAs laser diodes has been conducted.

In chapter 2, the basic concepts of heterostructure, Maxwell's equations, waveguiding and gain theory are given. In Chapter 3, the fundamentals of the growth mechanism of GaAs and GaAlAs and a newly developed sliding boat for LPE growth by a combined technique are presented. Chapter 4 shows the procedure of LPE growth technique for fabrication of laser diodes. Chapter 5, the application of a combined technique to form single quantum well lasers and their quantum size effect is described in this chapter. Finally, the main conclusion obtained through out this work is summarized in the last chapter.