Features of laser diodes

Based on our practical implementation of molecular beam epitaxy (MBE) which has excellent control features and our development of an SAM laser with an ideal laser structure, we have succeeded in the hitherto unthinkable mass production of our RLD series of laser diodes.
An example which compares the dispersion of θ⊥ and θ// characteristics of our RLD-78MA with a previous product is shown in Fig. 9. Dispersion has been reduced to less than one-third that of the previous product, and this tight dispersion range means that we can consistently supply large quantities of laser diodes which are optimum for the target application.

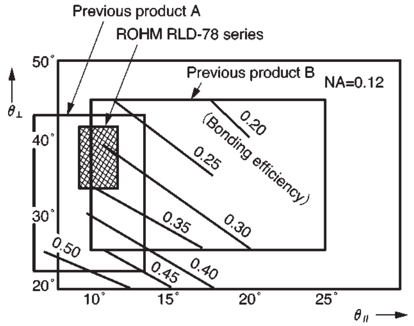

Fig. 9 Far-field dispersion

• Features of molecular beam epitaxy
In recent years the market for compact discs, video discs, and optical memory such as optical disc files has been expanding rapidly. In addition, the demand for laser beam printers in the office automation market has been growing dramatically. All of these products use Al GaAs laser diodes for their light source. Laser diodes are normally made by a liquid layer growth method called liquid phase epitaxy. However, ROHM has become the world's first manufacturer to produce laser diodes by molecular beam epitaxy (hereafter called MBE), which allows precise control of composition and layer thickness.
To use a laser diode as a data-reading light source in optical discs, a variety of optical characteristics including current and output must be satisfied. ROHM has independently developed a stripe structure which is suited to MBE. The stripe structure is explained in detail in the following.
Fig. 10 shows the stripe structure manufacturing process. First, six epitaxial layers are grown by MBE. The wafer is then removed from the MBE device and stripes are made by photo-lithography and chemical etching. The key point at this time is to leave a 0.1 μm protective surface layer of n-GaAs. This protective layer is removed by evaporation during thermal etching in the third stage of MBE. Thermal etching is based on the fact that GaAs will re-evaporate at a certain temperature while AlGaAs

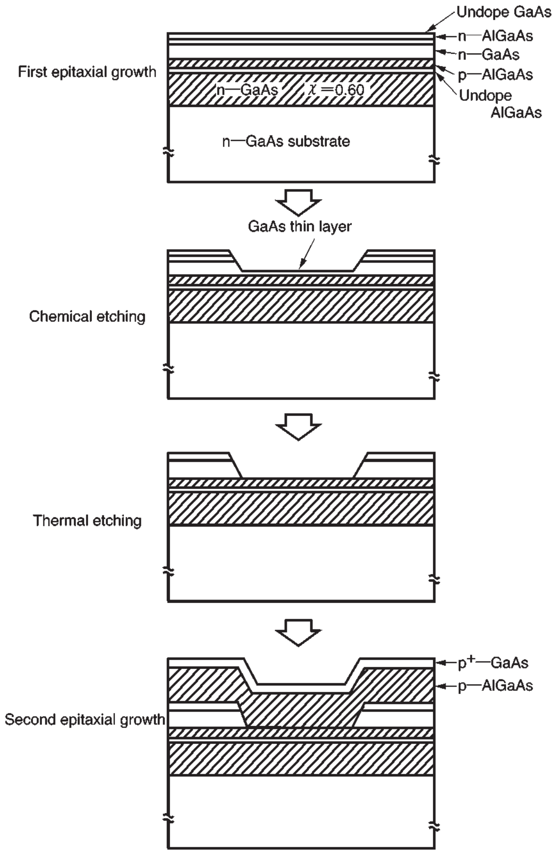

Fig. 10 Manufacturing process of stripe structure

will not, and it causes a clean and pure AlGaAs layer to appear. Crystal growth is then carried out a second time while the wafer is still in the MBE machine forming the cladding and cap layers.
After the process shown in Fig. 10, the electrodes are vacuum-deposited on the top and bottom faces, cleaved, and a facet protection layer is applied to complete the laser chip. Optical characteristics important for optical disc light sources include the characteristics of the transverse and longitudinal modes, noise, and astigmatism. The transverse mode is determined by stripe width, active layer thickness, and the refractive index of the cladding and active layers. MBE allows precise control of these parameters for a stable transverse mode.
Longitudinal mode, noise, and astigmatism characteristics are interrelated. Through precise control of stripe width, active layer thickness and cladding thickness, we have achieved a stable longitudinal multimode oscillation, reduced the occurrence of noise, and held astigmatism to a level which does not affect the error rate.

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