Abstract

The present thesis deals with the optimization of a chain of processes required for the fabrication of a complete high-power laser diode package. These processes include: epitaxial growth, device-processing, facet-coating, packaging and device-testing.

The InGaP quantum-well laser diode structure is grown using metal-organic vapor phase epitaxy. The growth conditions have been optimized for each layer of the multilayer structure. The ex-situ device-processing after the epitaxial growth of laser diode structure is also very important in order to achieve high-power continuous-wave operation and have been optimized to fabricate edge-emitting laser diode bars out of the grown wafers of quantum-well structure.

Design and optimization of anti-reflection and high-reflection coating of dielectric thin films on the front and the back facet of the laser diode, respectively, are discussed. The facets-coating was carried out on various laser diode structures with different lasing wavelengths besides the MOVPE grown quantum-well structure, and the effects of facet-coating on laser diode characteristics have been examined. The setup and automation of various laser diode characterization facilities have also been implemented.

The packaging processes for high-power laser diode viz. die-bonding and wire-bonding were optimized using different solder materials and carried out on a facet-coated high-power highly-strained InGaAs quantum-well laser diode bar. Continuous-wave operation of the packaged laser diode assembly has been demonstrated.