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Improvement of Characteristic Temperature for AlGaInP Laser Diodes

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Abstract

An optimized 650-nm AlGaInP multiple-quantum-well (MQW) laser, which has a compressively strained graded-index separate confinement heterostructure (GRIN-SCH), with improved characteristic temperature, is described. We theoretically show that the parabolic GRIN-SCH has a better carrier injection and smaller overflow than the conventional step-SCH for the AlGaInP LD under identical optical confinement. We have also calculated the electron distribution in the quantum wells for both GRIN-SCH-4QW and SCH-4QW at high temperature. The results indicate that the electron leakage to the p-cladding layer is greatly reduced if the GRIN-SCH-4QW structure is used. We have also compared the performance of LDs with different GRIN-SCH profiles and found that the parabolic GRIN-SCH is better than linear GRIN-SCH in terms of carrier confinement. We have further demonstrated the performance of AlGaInP LDs with four different structures (4-QW step-SCH, 5-QW step-SCH, 4-QW parabolic-GRIN-SCH and 5-QW parabolic-GRIN-SCH). Both theoretical and experimental results indicate that the laser diode with GRIN-SCH-4QW shows the best laser performance among the three structures. A characteristic temperature of 110 K has been demonstrated.