Opt Quant Electron (2013) 45:401–410
DOI 10.1007/s11082-012-9645-1

Stable high optical power in quantum well lasers with profiled reflection and tapered structures

Amire Seyedfaraji · Vahid Ahmadi · Mahyar Noshiravani

Received: 15 August 2012 / Accepted: 10 December 2012 / Published online: 20 December 2012

Abstract A comprehensive model is presented to study quantum well tapered lasers and quantum well stripe lasers with profiled reflectivity output facets and to obtain lateral stability in high power semiconductor laser. Simulation of semiconductor lasers is performed by numerically solving space-dependent coupled partial differential equations for the complex optical forward and backward waves, carrier density distribution and temperature distribution. The coupled equations are solved by finite difference beam propagation method. The effect of nonlinear parameters like Kerr and linewidth enhancement factors, and precise dependence of linewidth enhancement factor and gain factor on the carrier density and temperature are considered in this paper. We use modal reflector in stripe lasers to confine the lateral mode to the stripe centre and provide the stable operation. We also use unpumped window to reduce the facet temperature and improve the catastrophic optical mirror damage level of tapered lasers.

Keywords High optical power · Quantum well laser · Profiled reflection · Tapered structures

1 Introduction

During the last few years, great progress has been made in the development of high-power and high-brightness laser diodes (Bull et al. 2005; Erbert et al. 2001). These devices have found increased applications in pumping solid state or fiber laser systems for industrial, medical and direct material processing applications (Zhang et al. 2010; Li et al. 2010).

For high-power performance, the optical mode volume of semiconductor laser source has to be large enough to reduce the junction temperature and the optical power density at the laser

A. Seyedfaraji · V. Ahmadi (✉)
Department of Electrical and Computer Engineering, Tarbiat Modares University, Tehran, Iran
e-mail: v_ahmadi@modares.ac.ir

M. Noshiravani
Laser Research Center, Tehran, Iran