

# Designing an all epitaxial 1,550 nm intra-cavity VCSEL using GaInAsN/AlGaInAs in the active region and AlGaAsSb/AlAsSb in top and bottom DBRs

Arnob Islam · Samiha Ishrat Islam · Saiful Islam

Received: 26 March 2013 / Accepted: 3 July 2013 / Published online: 14 July 2013  
© Springer Science+Business Media New York 2013

**Abstract** In this paper, a 1,550 nm Intracavity structure vertical cavity surface emitting laser (VCSEL) has been designed using quaternary compound QW/barrier materials of GaInAsN/AlGaInAs matched with InP substrate. This choice has been made instead of choosing widely used GaInAsP/InP and AlGaInAs/InP to gain some advantages. In addition to the introduction of new combination in the active region, a different compound semiconductor combination AlGaAsSb/AlAsSb has been used as the DBR material for achieving lattice matching and also for achieving higher refractive index contrast. Compared to widely used GaAs/AlGaAs DBR mirror system, which needed wafer fusion with the top and bottom sides of the active region at 1,550 nm, the chosen DBR of this design is advantageous. The active material compositions have been chosen to obtain a peak gain at 1,550 nm and all other compositions have been chosen to obtain close lattice match at the same time to obtain the desired bandgap at the desired layers. The end result of this design is a VCSEL based on InP substrate which is capable of producing 1,550 nm light output and which can be constructed using widely used epitaxial techniques because all of the layers are lattice matched.

**Keywords** Diode laser · VCSEL · MQW · DBR

## 1 Introduction

Semiconductor lasers in the long wavelength (LW) range around 1,300 and 1,550 nm with wide-temperature-range operation are much needed devices in the fast developing optical

---

A. Islam · S. Islam (✉)  
Department of Electrical and Electronic Engineering, Bangladesh University of Engineering and Technology, Dhaka 1000, Bangladesh  
e-mail: sislamk@yahoo.com

A. Islam  
e-mail: arnobislam@ymail.com

S. I. Islam  
Department of Electrical and Electronic Engineering, American International University-Bangladesh, Dhaka 1213, Bangladesh  
e-mail: smhislam@gmail.com