MODELING DESIGN AND FABRICATION OF LATERALLY-CORRUGATED RIDGE-WAVEGUIDE DISTRIBUTED FEEDBACK LASERS

A. Laakso, J. Viheriala, J. Karinen, M. Dumitrescu and M. Pessa

Optoelectronics Research Centre, Tampere University of Technology, PO Box 692, FIN-33101, Tampere, Finland
email: Antti.I.Laakso@tut.fi

The simplicity of their structure combined with the good wavelength selectivity of the integrated Bragg gratings make distributed feedback (DFB) lasers the favored single-longitudinal-mode edge-emitting laser (EEL) device. The conventional DFB-EEL designs are based on embedding a grating deep into the epilayer structure, whereas our approach uses laterally-corrugated ridge-waveguide (LC-RWG) structures (sketched in the upper panel of Fig. 1), which enable a single growth and processing sweep, thus increasing the yield and reducing the fabrication cost.

The $\kappa L$-value (i.e. the product of the coupling coefficient and device length) is a key design parameter of any type of DFB-EEL. The methods used for calculating the coupling coefficient in conventional DFB structures with embedded gratings involve approximations which are not valid for calculating the coupling coefficient in LC-RWG structures. An improved method, which enables accurate coupling coefficient calculation for LC-RWG structures is proposed and compared with the existing methods. The effects of laterally-corrugated ridge geometry (i.e. grating duty cycle, etching depth, ridge width $W$ and lateral extension of the ridge corrugation $D$) both on the coupling coefficient and on the Bragg wavelength of different transverse modes are discussed. The improved modeling has been used to design 980 nm DFB-EELs with laterally-corrugated ridge-waveguide third-order gratings. The lasers fabricated using nanoimprint lithography exhibited single-mode operation with 50 dB side-mode suppression ratio (Fig. 2).

![Fig. 1. Sketch (upper panel) and SEM picture (lower panel) of a LC-RWG structure](image1)

![Fig. 2 LIV characteristics and emission spectra for the fabricated LC-RWG DFB-EEL](image2)