THE EFFECT OF TEMPERATURE ON THE STRUCTURE DFB LASER AND ITS EFFECT ON THE PHENOMENON OF SHB

Ebrahim Fooladi

Department of Electrical and Electronics, Hormozgan Science and Research Branch, Islamic Azad University, Tehran, Iran

*Author for Correspondence

ABSTRACT

In this paper, coefficient of deflection and coupling of transmitted self amplified spectrum (ASE) in laser with expanded feedback in conditions of threshold and above in different structures is simulated. Calculations showed that with addition of thermal conditions (ASE) the beam changes to longer wavelengths and it is because of connection between wavelength and coefficient of thermal failure. In above threshold, the figure of (ASE) will change to shorter wave lengths. Calculations also showed that there is a reduction in threshold with increase in thermal condition and the coefficient of thermal defeat that the reason is connection between energy gap and coefficient of thermal defeat. In threshold level with different Thermal conditions increasing in heat will result in lowering effect of (SHB).

Keywords: Laser with Expanded Feedback (DFB), SHB Effect, Threshold Current, Heath, Coefficient of Dispatched Self Amplification Spectrum (ASE)

INTRODUCTION

Because of wide usage of semiconductor lasers in optical communication with access to the production of fiber optics and making of light streams, this technique made a great change in information era. In the recent years we have lots of articles about semiconductor lasers, physics, theory, how they work, and applications (Agrawal, 1988; LiSimin, 2010; Ghafoori-Shiraz, 2003; Morthier, 2004; Huang, 2002). Also there was a vast research for increase in efficiency of DFB semiconductor lasers and compensating the DFB effect in different optical networks (Morthier, 2004; Huang, 2002; M’ohrleMartin, 2006). Among these structures there are (multiple phase shift), (modulated grating corrugation-pitch) and chirp structure with phase shift. One of the main difficulties in laser is the uniform distribution of field, this means using the effective way of laser cavity and getting a uniform reflection of it. In action, because of none uniformity of field distribution in DFB lasers, we can see the effect of SHB (spatial hole burning) and reduction in efficiency. In this research, we study different ways of SHB compensations and will choose the best method.

Simulations

Thermal Dependency of Coefficient Deflection in Different Layers of Active Covering Areas

In this part, we analyze the effect of temperature in structure of DFB laser with deflection coefficient.

Figure 1: Simple diagram of DFB laser with five layers and mesh structure in glow and covering border
For calculations first we should get results of deflection coefficient and changing of this parameter with the temperature. Figure (1) drawing, structure of five layers in DFB laser is shown. The mesh area in the border between glowing and covering layer is visible. The factor of deflection coefficient in laser with distributed feedback shows, with increase thickness of active layer, density of vector is increased and electrical field will be higher and with increase in temperature, density of vectors visually increases and causes growth in deflection factor and electrical field. Figure (2) shows the deflection factor with respect to the thickness of active region. Figure (3) and (4) shows alteration in deflection factor of thickness in active region of two mesh structures with different amplitudes. As we can see in both figures with increase in thermal condition, coefficient of effective deflection is increasing and because of increase in vector density with temperature, it causes to limit the light beam. But meshes with bigger amplitude, because of having thicker glowing layer and more controlling of intensity in active layer have more effective deflection factor.

**Figure 2:** Effective deflection factor according to thickness of active region in DFB laser

**Figure 3:** Effective deflection factor in active region according to different thermal conditions in $a=0.05 \mu m$

**Figure 4:** Effective deflection factor in active region according to different thermal conditions in $a=0.08 \mu m$
Thermal Relations of Matching Factor and Calculation of Light Limitation in Mash and Active Regions

In figures (5) and (6) matching factor in two different structures of mesh amplitude was discussed. In these structures, with increase in mesh amplitude, matching factor, there will be increase in matching factor and this addition in 0/08μm is more than 0/05μm mesh. Also with increase in temperature, because of light limitation factor in active region, matching factor will decrease.

It should be known that with the increase in temperature, the light limitation factor in active region in lasers with 0/08μm mesh will be less than the same with 0/05μm but light limitation factor of active region will be increased.

Figure 5: Matching factor according to mesh thickness (a= 0/05μm) in different thermal conditions

![Graph 5](image5)

Figure 6: Matching factor according to mesh thickness (a=0/08μm) in different thermal conditions

![Graph 6](image6)

In figure (9) changes in matching factor with depth of grooves in square mesh for different thickness is displayed.

As can be seen matching factor will increase with increase in groove depth of mesh because of amplification in amplitude of signal, swing and feedback will increase but with active layer thickness, it will diminish.

This is because thickness of active layer causes the less electrical field to be propagated in mesh and results in decrease in matching amplitude swing and feedback in mesh region.

© Copyright 2014 | Centre for Info Bio Technology (CIBTech)
Thermal density relations of current threshold in length of Cavity in different matching conditions and calculations of $I_0$ and $T_0$ in relation $I = I_0 e^{T/T_0}$

As regards, density of current $J_{th}$ has connections with many parameters such as depth of grooves, Cavity length, coupling factor, thickness of active layer and wave conditions.

Figure (7) and (8) displays the change in threshold density with respect to temperature and length of Cavity.

Figure (7) shows that, with increase in cavity length, density of threshold current will decrease and figure (8) shows, process of decreasing threshold current density is so that, with increase in temperature, density of threshold current in longer length Cavities will not change.

As we can see in the diagram, density of threshold current in temperature $T=273k$ in length $L>220 \mu m$ and in temperature. $T=300K$ in length of $L=350 \mu m$ is constant and there is no visible change.
Change in threshold current $I_{th}$ according to length of Cavity is studied in figure (9), threshold current first with increase in Cavity length decreases and in $L=300\mu m$ reaches to its minimum and then with increase in length of Cavity, increases.

Two different thermal conditions, $T=300K$ and $T=273K$ with the same amount, shows that with increase in temperature threshold current increases and in bigger lengths it will increase farther more.

Relocation of spectrum to upper wave lengths in each centigrade of thermal condition is equal to 0.01nm. Figure (9) shows the change in automated transmitting spectrum according to wave length in different temperature conditions for light amplitude $a=0.06\mu m$, was regenerated with the same factors that result shows increase in AES amplitude is corresponding with mesh amplitude multiplication, but this spectrum amplitude stays constant and changes to upper wave lengths.
Density change in carriers, photons according to current and temperature in length of Cavity. Carrier density (nez) and photon density (npz) in \( T=300k \) in different current conditions displayed in figure (10) and (11) as we can be see, in constant thermal conditions, with increase in current in length of Cavity, density of carrier is increasing and also this density in middle of Cavity, for the reason of phase change will reach to its minimum whilst density of photons will be at most in this point.

Figure 11: Changes in ASE according to \( \lambda \) in different thermal conditions

Figure 12 shows additional current photons will increase in the length of Cavity. Figure (12) shows that with increase in temperature, density of carriers will extremely increase but they are uniform in length of Cavity. But in figure (13) increase in temperature causes to decrease number of photons.
Review Article

Figure 13: Photon density in length of Cavity in different current conditions in temperature T-300K

Figure 14: Density of carriers in length of Cavity in different currents in above threshold conditions

Figure 15: Photon density in length of Cavity in different currents in above threshold conditions
CONCLUSION
Result of this study shows that as for the connection between diffraction coefficient and energy gap in different mole fractions, diffraction coefficient with adding the mole fraction will be increased. With addition of mesh amplitude, coefficient of matching will also be increased but with increase in temperature because of decrease in light limitation in this region the matching factor decreases. With increase in matching coefficient, current density and threshold current will be reduced because of increase in electrical field. In threshold conditions, transmitted amplitude spectrum is not amplified automatically but for each centigrade change 0/1nm will shift to higher wave lengths.
The output power of laser in above threshold and different mesh amplitudes with other current and temperature conditions, showed that with increase in current, output power increases but with temperature increase will decrease wihles with increase in mesh amplitude, threshold current will be reduced.

REFERENCES