


利用光纖光柵之穩頻DFB半導體雷射及其注入鎖定外腔式 半導體雷射之研究

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摘要



在本論文中，我們利用一個簡單且有效的方法來做DFB半導體雷射的穩頻。利用光纖布拉格光柵作為頻率的鑑別器，將雷射的頻率鎖在光纖光柵的穿透頻譜上。穩頻的結果可分為短時間及長時間的衡量，對於短時間穩頻的結果，4分鐘之內可以將頻率擾動降至22MHz，而對於將近17小時的量測，雷射頻率的擾動仍在50MHz以下。

我們將上述穩頻好的DFB半導體雷射注入鎖定到外腔式半導體雷射內，並觀察外腔式半導體雷射輸出頻率的變化。發現當外腔式半導體雷射操作在臨界電流之下，輸出頻譜由DFB半導體雷射所決定，其頻率擾動可以降到大約23MHz。而若外腔式半導體雷射操作在臨界電流之上，我們發現在一開始注入鎖定時，外腔式半導體雷射輸出波長可以被DFB半導體雷射拉住，但是經過一段時間，輸出頻譜將出現波形分裂的現象，我們推斷這是因為外腔式半導體雷射與DFB半導體雷射相互競爭的結果。

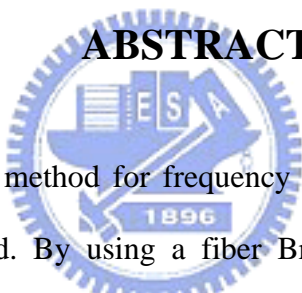
A Study of Frequency Stabilization of a DFB Laser Diode Using a Fiber Bragg Grating and Injection Locking of External-Cavity Semiconductor Laser

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ABSTRACT

The logo of National Chiao Tung University is a circular emblem with a gear-like border. Inside the circle, there is a stylized building and the letters 'ES' and 'A'. Below the building, the year '1896' is inscribed.

A simple and effective method for frequency stabilization of distributed feedback (DFB) laser diode is proposed. By using a fiber Bragg grating (FBG) as a frequency discriminator, the wavelength of DFB is locked to the side of transmission profile of the FBG. The frequency fluctuation of the DFB laser LD reduced to 50 MHz after stabilization for a period of 17 hour. The square root of the Allan variance is 3.25×10^{-9} at sampling time of 60s.

At the second part of our experiment, we do the injection locking of the external cavity semiconductor laser (ECL) by using our stabilized DFB laser diode. When the ECL is operated at $(I/I_{th}) = 0.96$ below threshold, from the error signal, we get the frequency fluctuation of ECL is about 23MHz during one-hour measurement. When the ECL is operated at $(I/I_{th}) = 1.09$ above threshold, we find the waveform of ECL splits into two modes because the ECL competes with the DFB laser.

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~謹以此論文獻給我最親愛的爺爺奶奶~

于新竹 交大

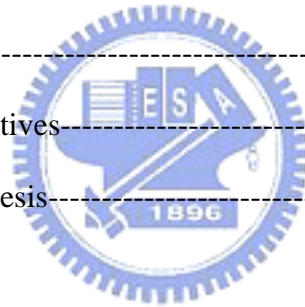
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