

**BRILLOUIN FIBER LASER BASED ON PHOTONIC CRYSTAL FIBER**

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**UNIVERSITY OF MALAYA  
KUALA LUMPUR**

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**BRILLOUIN FIBER LASER BASED ON PHOTONIC CRYSTAL FIBER**

**By**

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## ABSTRACT

This dissertation studies the performance of single and multiwavelength fiber laser in a short length of Photonic Crystal Fiber(PCF). The result were studied in PCF compared with the results were studied in 25km of normal single Mode Fiber (SMF). Several design of Multiwavelength Brillouin Erbium Fiber Laser (MWBEFL) systems with capability to become a potential multi- source in Dense Wavelength Division Multiwavelength (DWDM) are presented. MWBEFL is a special laser source that used to produce a multiple channels simultaneously with dense and constant spacing around 0.09nm or 10GHz. In this dissertation, the combinations of two gain medium (Brillouin gain medium and Bi-EDF gain) with high nonlinear properties of fiber were used. Brillouin gain was developed in 20m PCF, while 0.5m of Bismuth Erbium Doped Fiber (Bi-EDF) used as Bi-EDF gain. An amplifier was design to boost up the high power to generate a comb of multiwavelength brillouin fiber laser. To design an amplifier, the combination of 0.5m  $\text{Bi}_2\text{O}_3$  and normal Erbium doped fiber (EDF) were used to reach output power as high as 20dBm. After the characterization of PCF, the generation of brillouin in PCF was studied using a standard BFL and BEFLconfiguration. In effort to enhance the result of MWBEFL, a modification has been done by insert a looping back at two end of PCF. Through this modification, results slightly better than the previous configuration. Besides, single wavelength brillouin fiber laser with Raman amplification also has been studied on a length of normal SMF.

## ABSTRAK

Disertasi ini mengkaji prestasi penjanaan panjang gelombang tunggal dan panjang gelombang berbagai fiber laser dalam Fiber Fotonik Hablur(PCF) yang pendek. Keputusan yang dikaji dalam PCF dibandingkan dengan 25km panjang Fiber Mode Tunggal(SMF). Beberapa rekabentuk sistem Panjang Berbagai Brillouin Dopan Erbium Fiber Laser(MWBEFL) dengan kebolehan untuk menjadi sumber saluran berbagai yang berupaya dalam sistem Pembahagian Panjang Gelombang Padat(DWDM) dipersembahkan. MWBEFL adalah sumber laser yang istimewa yang digunakan untuk menghasilkan gandaan saluran secara serentak dengan padat dan jarak bersebelahan yang tetap sekitar 0.09nm atau 10GHz. Dalam disertasi ini, kombinasi dua medium penggandaan (penggandaan Brillouin dan penggandaan Bi-EDF) dengan ketaklinearan fiber yang tinggi masing-masing digunakan. Penggandaan Brillouin dibangunkan dalam 20m panjang PCF manakala 0.5m Bismuth digunakan sebagai penggandaan Bi-EDF. Suatu pengganda direka untuk meransang kuasa tinggi untuk menjana satu sisiran panjang gelombang berbagai fiber laser. Untuk merekabentuk peransang pengganda, suatu 0.5m panjang fiber  $\text{Bi}_2\text{O}_3$  dan kombinasi dengan Pengganda Fiber Erbium Dopan (EDFA) biasa digunakan untuk mencecah kuasa keluaran setinggi 20dBm. Selepas pencirian PCF, aplikasi Brillouin dalam PCF dikaji menggunakan konfigurasi BFL dan BEFL yang piawai. Sesisir panjang gelombang berbagai fiber laser dihasilkan dengan konfigurasi ini. Dalam usaha untuk menambah baikkan hasil kajian MWBEFL, suatu pengubahsuaian dibuat dengan memasukkan satu gelung berbalik di kedua-dua hujung PCF. Menerusi pengubahsuaian ini, hasil kajian sedikit baik berbanding dengan

konfigurasi yang sebelumnya. Selain itu, panjang fiber laser gelombang tunggal dengan penggandaan Raman juga dikaji ke atas suatu panjang fiber mod tunggal yang biasa.

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