

# 國立交通大學

光電工程研究所

碩士論文

利用光子晶體光纖製做長週期光纖光柵與超連續光

譜

**Long-Period Grating and Supercontinuum  
Generation Using Photonic Crystal Fiber**

研究生：陳厚仁

指導教授：謝文峰 教授

林奎輝 教授

中華民國九十七年六月

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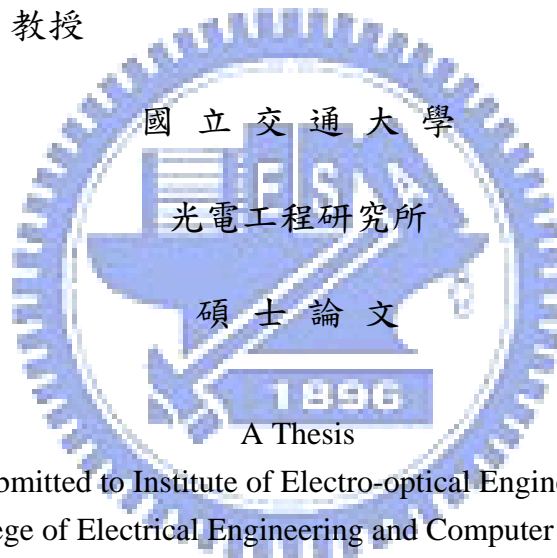
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# 利用光子晶體光纖製作長週期光纖光柵與超連續光譜

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## 摘要

在此篇論文，我們研究兩個主題：第一，我們使用兩種鋸齒狀元件在光子晶體光纖上產生易變、可調的長週期光纖光柵。長週期光柵的中心波長、截止頻帶和穿透損失可以被大範圍的調整。我們在啾頻的長週期光柵上觀察到不等間距的干涉條紋，干涉條紋與交互作用的長度和長週期光柵兩端啾頻的程度有關，干涉條紋可以被消除，當我們減小交互作用的長度和啾頻的量。藉著利用這可調的長週期光柵，我們也對摻鉍光纖放大器作增益平坦化，並且也被證實。第二，我們也研究不同起始穿透率摻鉍鈮鋁石榴石之摻鉍鈮酸鈣固態激發的 Q-開關 (Q-switched) 鎖模雷射。在輸出耦合鏡反射率  $R = 60\%$ ，飽和吸收體穿透率  $T_0 = 40\%$ ，並且激發功率 15 瓦時，有最大的 Q-開關波包脈衝能量大約 0.096 毫焦耳。最後，我們藉由高脈衝能量的 Q-開關鎖模雷射耦合至光子晶體光纖，產生了 950 nm 至 1450 nm 寬的超連續光譜。

# Long Period Grating and Supercontinuum Generation Using Photonic Crystal Fiber

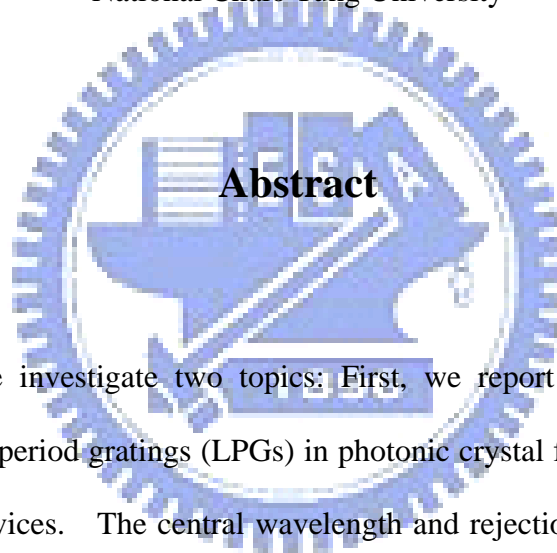
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In the thesis, we investigate two topics: First, we report a method for generating versatile tunable long-period gratings (LPGs) in photonic crystal fibers (PCFs) by using two kind of corrugated devices. The central wavelength and rejection bandwidth of LPGs can be tuned over a broad spectral range with adjustable transmission loss. Spectral fringes with uneven spacing were observed in chirped LPGs, depending on the interaction length and the amount of chirping between the two ends of the LPG, and can be removed by reducing interaction length and chirping. By utilizing a stress-induced LPG, gain flattening of an erbium-doped fiber amplifier has also been demonstrated. Second, We investigated the Q-switched and mode-locked operation in a diode-pumped Nd:GdVO<sub>4</sub> laser by the permutation of initial transmittance  $T_0$  of Cr<sup>4+</sup>:YAG crystal. The highest pulse energy of Q-switched envelope about 0.096 mJ with output coupler of  $R = 60\%$  and initial

transmission  $T_0 = 40\%$  of a Cr:YAG saturable absorber can be obtained at the 15 W pump power. Finally, supercontinuum is generated by using a Q-switched mode-locked laser coupling into photonic crystal fiber.



## 致謝

還記得不久前才剛考完碩士班入學考試，進到小天王實驗室，兩年的時間，轉眼間就過去了，即將從小天王實驗室畢業，但是隨即又再度進到小天王實驗室@@”，同時也是邁入另一個階段，首先，當然要感謝這兩年間謝老闆的悉心指導，很有耐心的陪我們研讀論文，培養我們撰寫文章和口頭報告的技巧，也教導我們很多做人處事的道理，並且總是以聊天的方式來緩和 meeting 緊張的情緒；以及林奎輝老師總是會撥空來交大和我討論課業，實驗上問題，也會常常關心我生活上的事情，尤其在日本報告的那段時間，承蒙老師的照顧，帶著我們四處遊玩，真是謝謝林奎輝老師；家弘學長在討論上和實驗上幫助我很多，讓我獲益匪淺，並且在韓國報告期間，途中還感冒發燒，在藥局買成藥越吃越嚴重 =.=，謝謝學長的照顧，當然不能忘記好久不見的“胖奶油”，長期在實驗室中伴隨著大家。

這兩年期間，和碩二的夥伴從一開始的不太熟到最後培養了深厚的情誼。陳 IC 啊!!陳 IC，這兩年應該和你最熟了吧!!碩一的時候一起坐在裡面，雖然你常常會”肖肖”，但還是常常幫我解決很多程式的 Bug…你是高手!!，碩二的時候發現你不只肖肖，還很”鹹濕” XD；B47 的另一個成員，小詹，妳做事的嚴謹總是讓我印象深刻，但是迷糊也是讓我印象深刻 XD，碩二的時候能一起到日本報告加旅遊，這是一個很好的回憶，妳也是我見過最純真的女生 >/////< ；賴小新，(小賴，賴阿婆)，妳真是實驗室的開心果，實驗室如果少了妳，應該就不會這麼熱鬧了吧，回想什麼時候開始和妳變熟的，我想是碩一和妳在圖書館看固態物理到半夜那時候開始吧…哈，碩二的時候也常常討論到半夜，其實大部分時間都在”拉賽” XD，也謝謝妳請我吃大餐，也祝妳到美國這八個月一切順利，如果我有去參加研討會，在去讓妳包吃包住，還有，一年後我會變瘦的=.+=；香腸(吸哥)，碩一的時候真的和你不熟，一度還覺得你是怪角 XD(不要恨我)，後來才發現你是高手，真後悔沒在妳身上學個一招半式，真是虧大了；伍佰，碩一的

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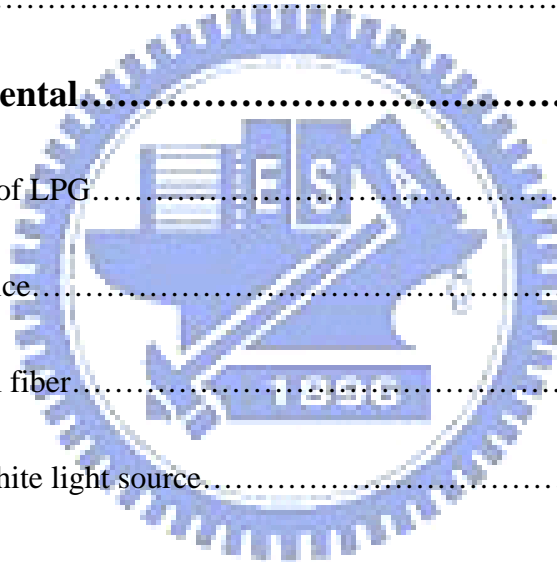
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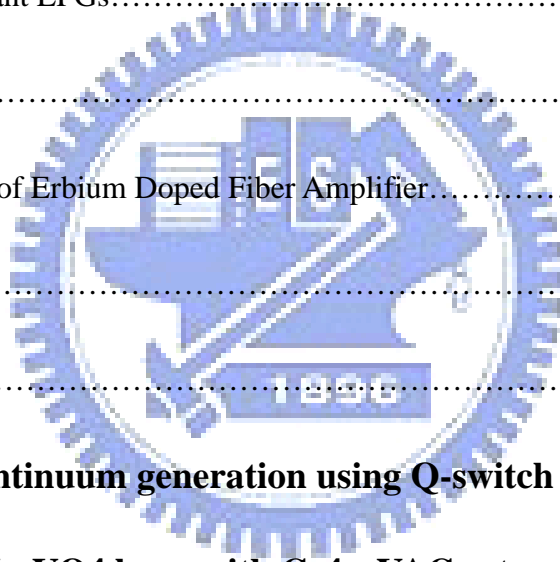
Abstract (in Chinese).....	i
Abstract (in English).....	ii
Acknowledgement.....	iii
Content.....	vi
List of figures.....	ix
List of tables.....	xii
<b>Chapter 1 Introduction.....</b>	<b>1</b>
1.1 Significance of this thesis.....	1
1.2 Background.....	1
1.2.1 What are photonic crystal fibers.....	1
1.2.2 Applications of photonic crystal fibers.....	5
1.2.3 Supercontinuum generation using PCFs.....	5
1.2.4 Fiber gratings.....	7
1.2.4.1 Fiber Bragg grating.....	7
1.2.4.2 Long period grating.....	11
1.3 Why long period grating made of photonic crystal.....	13
1.4 Why Q-switched mode-locked solid state laser.....	14



1.5 Organization of the thesis.....	15
References.....	16
<b>Chapter 2 Theory.....</b>	<b>22</b>
2.1 Dispersion relation of PCF -- beam propagation method.....	22
2.2 Coupled mode theory of long period grating.....	25
2.3 Model for passively Q-switched laser with simultaneous mode-locking.....	29
References.....	35
<b>Chapter 3 Experimental.....</b>	<b>36</b>
3.1 Experimental setup of LPG.....	36
3.1.1 Corrugated device.....	36
3.1.2 Photonic crystal fiber.....	37
3.1.3 Un-polarized white light source.....	38
3.1.4 Measurement of transmission spectra of LPG.....	38
3.2 Experimental setup of Supercontinuum.....	40
3.2.1 Q-switched mode-locked laser.....	40
3.2.2 Supercontinuum generation.....	43
<b>Chapter 4 Stress-Induced Versatile Tunable Long-Period Grating in Photonic Crystal Fibers.....</b>	<b>44</b>
4.1 Transmission spectra of LPGs made by V-grooved.....	44



4.1.1 Constant LPG.....	44
4.1.2 Chirped LPGs.....	46
4.1.3 Polarization dependent LPG.....	48
4.1.4 Generation and elimination of spectrum fringe.....	50
4.2 Transmission spectra of LPGs made by metallic post.....	52
4.2.1 Chirped LPGs.....	52
4.3 Simulation of constant LPGs.....	54
4.4 Application.....	59
4.4.1 Gain flattening of Erbium Doped Fiber Amplifier.....	59
4.5 Summary.....	60
References.....	62
<b>Chapter 5 Supercontinuum generation using Q-switch mode-locking Nd:GdVO4 and Nd:LuVO4 laser with Cr<sup>4+</sup>:YAG saturable absorber.....</b>	<b>63</b>
5.1 Q-switch mode-locking Nd <sup>3+</sup> :GdVO <sub>4</sub> with Cr <sup>4+</sup> :YAG saturable absorber.....	63
5.2 Simulation of Q-switching mode-locking.....	69
5.3 Supercontinuum generation by QML laser using PCFs.....	71
5.4 Summary.....	72
<b>Chapter 6 Conclusions and future works.....</b>	<b>73</b>



## List of Figures

Fig. 1.1 Scanning electron microscope image of the end of photonic-crystal-fibers for index-guiding PCF and photonic bandgap fiber.....	4
Fig. 1.2 Phase mask technique for writing fiber Bragg grating.....	10
Fig. 1.3 The reflection and transmission spectra of a uniform Bragg grating.....	10
Fig. 1.4 A schematic diagram of a chirped fiber Bragg grating.....	11
Fig. 3-1 Novel corrugated devices: wrapping a long copper wire on a cylindrical metallic post, and V-grooved plate.....	36
Fig. 3-2 Scanning electron microscope image of photonic crystal fiber region and core.....	37
Fig. 3-3 Structure of un-polarized white-light.....	38
Fig. 3-4 Schematic of the experimental setup and generation of LPGs in PCFs by mechanical stress onto corrugated device.....	39
Fig. 3-5 Schematic diagram of diode-pumped Q-switched mode-locked Nd:GdVO <sub>4</sub> laser.	41
Fig. 3-6 Schematic diagram of noncollinear autocorrelator.....	42
Fig. 3-7 The experimental setup of supercontinuum generation.....	43
Fig. 4-1 Schematic of the mechanism for tuning the grating periodicity.....	45
Fig. 4-2 Measured transmission spectra of constant-period gratings obtained by adjusting the angle between the straight PCF and the V-grooves.....	45
Fig. 4-3 Resonant wavelengths measured at different grating periods, as well as the calculated effective indices differences with respect to resonance wavelengths. ....	45
Fig. 4-4. Transmission spectra for chirped single-LPG by the V-grooved metallic plate.....	48
Fig. 4-5 Transmission spectra for LPFG in PCF taken with polarized light and corresponding to maximum and minimum amplitudes of transmitted power.....	49
Fig. 4-6. Transmission spectra for Spectral fringes can be obtained from chirped single-LPGs,	

and the fringes can be eliminated with proper configuration.....	51
Fig. 4-7. Transmission spectra for Spectral fringes with different pressures.....	51
Fig. 4-8. Transmission spectra for spectral fringes can be obtained from chirped dual-LPGs, and the fringes can be eliminated with proper configuration.....	52
Fig. 4-9 Schematic of the chirped dual-LPG by period metallic post.....	53
Fig. 4-10. Transmission spectra for chirped single-LPG with different curvatures by wrapping a long copper wire on a cylindrical metallic post.....	54
Fig. 4-11. The cross section of PCF appear in the CAD windows.....	55
Fig. 4-12. Material dispersion of the high pure fused-silica fiber.....	56
Fig. 4-13. The effective index of core mode and high order cladding mode.....	58
Fig. 4-14. Transmission spectrum for simulation and experiment, and resonant wavelength is 1286 nm.....	58
Fig. 4-15. The gain flattened EDFA spectrum between 1528-nm and 1562 nm by using the chirped LPGs.....	60
Fig. 5-1. The average power versus pump power at CW state, and QML states with $T_0 = 80\%$ , 55%, and 40%.....	64
Fig. 5-2. Pulse train of QML with $T_0 = 40\%$ , and 80%.....	64
Fig. 5-3. Temporal expansion of Q-switching envelope of 80% $\text{Cr}^{4+}$ :YAG with fitting.....	66
Fig. 5-4. Temporal expansion of Q-switching envelope of 55% $\text{Cr}^{4+}$ :YAG with fitting.....	66
Fig. 5-5. Temporal expansion of Q-switching envelope of 40% $\text{Cr}^{4+}$ :YAG with fitting.....	67
Fig. 5-6. Repetition rates versus the pump power at the QML states with $T_0=80\%$ , 55%, and 40%.....	68
Fig. 5-7. The estimated pulse energy versus the pump power at the QML states with $T_0=80\%$ , 55%, and 40%.....	69
Fig. 5-8. Calculated result for the temporal shape of a single Q-switch pulse for saturable	

absorbers of  $T=40\%$  with  $R=60\%$ .....70

Fig. 5-9. Calculated result for the temporal shape of a single Q-switch pulse for saturable absorbers of  $T=55\%$  with  $R=60\%$ .....70

Fig. 5-10. Calculated result for the temporal shape of a single Q-switch pulse for saturable absorbers of  $T=80\%$  with  $R=60\%$ .....71

Fig. 5-11. The evolutions of spectral broadening for the experimental observation as pumping power increases.....72



## List of Tables

Table 4-1. The coefficient of Sellmeier equation used in highly pure fused-silica fiber. 56

