二維環形光子晶體雷射之設計與特性分析

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摘要

在本篇論文中，我們使用二維有限時域差分法計算出對稱性環形光子晶體雷射結構的光能隙、頻譜、和缺陷模態共振場圖。藉著這計算方法，我們能最佳化環形光子晶體雷射的設計，再把這些設計的元件確實的做出來。

為了分析二維環形光子晶體雷射的基本特性，我們利用自行架設的共焦顯微光譜系統量測作出來的元件並討論。藉由量測的結果與模擬的結果比較分析，可以得知我們量測到的雷射模態與我們預測的是相同的。並且藉由在共振腔中加個空氣孔洞去減少共振模態。最後，藉由跟準週期性光子晶體雷射作比較，我們可以得知環形光子晶體雷射有很好的雷射特性。

Design and Characteristics of Two-Dimensional Circular Photonic Crystal Lasers

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Abstract

In this thesis, we calculated the photonic band gaps, resonance spectra, and defect mode profiles of symmetric two-dimensional circular photonic crystal lasers by using 2D finite-difference time-domain method. These help us to optimize design of circular photonic crystal lasers. And, these designed two-dimensional circular photonic crystal micro-cavity lasers were fabricated.

In order to analyze the basic characteristics of two-dimensional circular photonic crystal lasers, we measured these lasers by a micro-scale photoluminescence system. We identified the lasing mode by comparing the measured results with the calculated results. Then, the side mode was reduced by adding central air hole. Finally, by comparing the lasing characteristics of circular photonic crystal lasers with these of 12-fold quasi-photonic crystal lasers, we found that the circular photonic crystal lasers have good lasing characteristics, such as ultra-low threshold and high quality factor.

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Content

Abstract (In Chinese)……………………………………………………………ii

Abstract (In English)……………………………………………………………iii

Acknowledgements…………………………………………………………..iv

Content…………………………………………………………………………..v

List of Figures………………………………………………………………….vii

Chapter 1. Introduction……………………………………1

1-1. Photonic Crystals……………………………………………………………1

1-2. Developments of Photonic Crystal Lasers………………………………..4

- 1-2-1. Photonic Crystal Cavity Lasers……………………………………4
- 1-2-2. Photonic Crystal Band Edge Lasers……………………………..7

1-3. Thesis Overview………………………………………………………………..9

Chapter 2. Simulation Methods…………………………...10

2-1. Introduction…………………………………………………………………...10

2-2. Plan-Wave Expansion Method…………………………………………….10

2-3. Finite-Difference Time-Domain Method………………………………..14

- 2-3-1. Maxwell's Equations and Yee Algorithm……………………....14
- 2-3-2. Boundary Conditions……………………………………………17
- 2-3-3. Grid Size and Stability Criterion………………………………..17

Chapter 3. Simulation Results…………………………….19

3-1. Introduction……………………………………………………………..19
3-2. Device Design…………………………………………………………..19
3-3. Symmetry and Photonic Band Gap of Circular Photonic Crystals……...21
3-4. Mode Analysis…………………………………………………………..24
3-5. Side Mode Elimination………………………………………………….28

Chapter 4. Fabrication and Measurement………………30

4-1. Introduction……………………………………………………………...30
4-2. Fabrication of the Photonic Crystal Lasers with Membrane Structure…30
4-3. Circular Photonic Crystal Lasers………………………………………..34
4-4. Measurement Results and Analysis……………………………………..36
  4-4-1. Measurement Setup……………………………………………..36
  4-4-2. Modes Identification…………………………………………….38
  4-4-3. Lasing Characteristics…………………………………………...39
  4-4-4. Comparison between Measurement and Numerical Results……42
  4-4-5. Side Mode Reduction…………………………………………...44
  4-4-6. Lasing Characteristics Comparison between Circular Photonic Crystal and 12 Fold Quasi-Photonic Crystal Lasers…………….45
4-5. Summary………………………………………………………………...48

Chapter 5. Conclusion……………………………………...50

References………………………………………………...51

List of Figures

Fig. 1-1. Simple examples of one-, two-, three-dimensional photonic crystals. The different colors represent materials with different dielectric constants. (P.1)

Fig. 1-2. This is TM band diagram of two-dimensional triangular lattice photonic crystal. “TM” denotes light with electric field in the plane of crystal. There is a photonic band gap between the first band (known as dielectric band) and the second band (known as air band). (P.3)

Fig. 1-3. (a) Point defect (b) Line defect. (P.4)

Fig. 1-4. The typical structure of two-dimensional photonic crystal laser. (P.5)

Fig. 1-5. Photonic crystal cavity geometries with different symmetries. (P.6)

Fig. 1-6. Six smaller air holes are added to increase side mode suppression ratio. (P.6)

Fig. 1-7. (a) The illustration of electrical pumping single defect photonic crystal micro-cavity. (b) The L-I curve of this photonic crystal laser. (P.7)

Fig. 1-8. The photonic band edge effect occurs in the circle. (P.7)

Fig. 1-9. Schematic structure of the surface-emitting laser has 2D triangular-lattice structure embedded by the wafer fusion technique. The inset shows the SEM photograph of the triangular-lattice structure. (P.8)

Fig. 1-10. (a) Schematic graded structure. The inset shows the SEM photograph. (b) The L-L curve of this photonic crystal band edge laser. (P.9)

Fig. 2-1. Yee’s unit cell. The $\vec{E}$ components are in the middle of the edges and the $\vec{H}$ components are in the center of the faces. (P.16)

Fig. 2-2. Temporal division of $\vec{E}$ and $\vec{H}$ components. (P.16)

Fig. 3-1. (a) The schematic of a circular photonic crystal micro-cavity laser. (P.20)
(b) The lattice geometry of circular photonic crystal. (P.21)

Fig. 3-2. The symmetry of circular photonic crystal. (P.21)

Fig. 3-3. Transmission spectrum of circular photonic crystal. The five different incident angles from (a) to (e) is 0, $\pi/18$, $\pi/12$, $\pi/9$, and $\pi/6$. (P.22)

Fig. 3-4. The transmission spectrum of circular photonic crystal with r/a= 0.38, 0.4, 0.42, and 0.44 at a fixed lattice constant = 520 nm. The inset shows the simulated structure and the position of the source and the monitor. (P.23)

Fig. 3-5. The photonic band gap shifts versus r/a ratio at a fixed lattice constant. (P.24)

Fig. 3-6. (a) The spectrum of D2 circular photonic crystal micro-cavity simulated by 3D FDTD method. The right and the left inset show the structure in the x-y plane and x-z plane.(b) The spectrum of D2 circular photonic crystal micro-cavity simulated by 2D FDTD method. The inset shows the structure in the xy plane. (P.25)

Fig. 3-7. The resonant spectrum of D2 circular photonic crystal micro-cavity. (P.26)

Fig. 3-8. (a) Calculated resonant mode frequencies of circular PC micro-cavity. Gray area indicates calculated photonic gaps of **A** in Fig. 3-3. (b) The mode profiles correspond to their symbols in Fig. 3-8 (a). (P.27)

Fig. 3-9. The resonant spectrum of D2 circular photonic crystal micro-cavity with and without central air hole. The inset shows the mode profile and the structure with central air hole. (P.28)

Fig. 4-1. The epitaxial structure with compressively strained/unstrained MQWs for photonic crystal lasers with membrane structure. The thickness of the membrane is about 220 nm. (P.31)

Fig. 4-2. The PL spectrum of the MQWs with highest gain peak at 1550 nm. (P.31)

Fig. 4-3. **(a)** Side view SEM and **(b)** top view SEM of circular photonic crystal lasers. (P.33)

Fig. 4-4. The overview of fabrication processes of two-dimensional photonic crystal lasers with membrane structure. (P.34)

Fig. 4-5. The top view SEM of two-dimensional circular photonic crystal laser array with five different electron dosage. (P.35)

Fig. 4-6. The top view SEM of two-dimensional D2 circular photonic crystal laser. (P.36)

Fig. 4-7. **(a)** The setup of micro-PL system. **(b)** The photo of real micro-PL system. (P.37)

Fig. 4-8. Measured resonant spectrum with 200 nm span and the calculated magnetic field distribution of each resonant mode. (P.38)

Fig. 4-9. The lasing spectrum in dB scale. (P.39)

Fig. 4-10. L-L curve of the WGM (k=6). The threshold of ~0.13 mW was observed in the inset and the rolling-off effect occurred as the input pump power was larger than 5.5 mW. (P.40)

Fig. 4-11. Lasing spectrum above threshold of the WGM (k=6). The lasing wavelength is 1574.35 nm. The inset shows lasing spectrum below threshold with 2 nm span. (P.41)

Fig. 4-12. The lasing wavelengths of a row lasers with varied lattice constant form 490 nm to 550 nm and a fixed r/a ratio. (P.42)

Fig. 4-13. Calculated resonant mode frequencies of circular photonic crystal micro-cavity. The white circles denote the measured lasing frequencies. Gray area indicates calculated photonic band gaps of A in Fig. 3-3. The inset shows the calculated magnetic field distribution of WGM (k=6). (P.43)

Fig. 4-14. The lasing spectrum of circular photonic crystal with and without central air hole. The top view SEM of real device and the side mode profile are shown inset. The side mode is effectively reduced by adding central air hole. (P.44)

Fig. 4-15. L-L curve of D2 circular photonic crystal micro-cavity laser with and without central air hole. (P.45)

Fig. 4-16. Top view SEM of (a) circular photonic crystal laser and (b) 12 fold quasi photonic crystal laser. (P.46)

Fig. 4-17. Lasing spectrum above threshold of the WGM (k=6). The lasing wavelength is 1574.35 nm and 1571.66, respectively. The inset shows lasing spectrum below threshold with 2 nm span. (P.47)

Fig. 4-18. L-L curve of the circular and 12 fold quasi photonic crystal laser. The thresholds are estimated to be 0.131 and 0.208 mW, respectively. The rolling-off effect is observed at 5.5 mW and 3.3 mW, respectively. (P.48)