

# CONTENTS

摘要 .....	i
Abstract .....	ii
序 (Foreword and Acknowledgement) .....	iii
Contents .....	v
Glossary of Acronyms .....	viii
<b>Chapter 1 – Introduction</b> .....	<b>1</b>
1.1 Background .....	2
1.2 Diode-Pumped Solid-State Lasers (DPSSLs) .....	3
1.3 Guide to the Main Text .....	3
<b>Part A – Intracavity Nonlinear Interaction of Laser and Material with Absorption</b>	
<b>Chapter 2 – Quantum-Dot Semiconductor Saturable Absorber Mirror (QD SESAM)</b> .....	<b>5</b>
2.1 Semiconductor Saturable Absorber Mirror .....	5
2.1.1 Mechanism of Semiconductor Saturable Absorber (SESA)	
2.1.3 Influence of Thickness	
2.2 Quantum-Well and Quantum-Dot Structure .....	8
2.3 InAs/GaAs QD SESAM for Diode-pumped PQS Nd-doped 1.3- $\mu$ m Lasers .....	9
2.3.1 Three-layer InAs/GaAs QD SESAM Grown by MOCVD	
2.3.2 Setup and Experiment Result	
2.4 InAs/GaAs QD SESAM for a Passively Mode-locked Nd:YVO <sub>4</sub> Laser at 1342 nm .....	14
2.4.1 Cavity Design and Setup	
2.4.2 Experiment Result	
2.5 Conclusion and Future Work .....	18
<b>Chapter 3 – Quantum-Well Semiconductor Saturable Absorber Mirror (QW SESAM)</b> .....	<b>19</b>
3.1 Semiconductor Material .....	19
3.2 InGaAsP QW SESA for Diode-pumped Passively Q-switched 1.34- $\mu$ m Lasers .....	20
3.2.1 InGaAsP QW/barrier structure grown on an Fe-doped InP substrate	
3.2.2 Setup and Experiment Result	
3.2.3 Conclusion	

3.3 InGaAs QW SESAM for Passively Pulsed Nd:YVO <sub>4</sub> Laser .....	26
3.4 Conclusion and Future Work .....	27
<b>Chapter 4 – Optical-pumped Vertical External Cavity Surface Emitting Laser (VECSEL) .....</b>	<b>29</b>
4.1 Vertical External Cavity Surface Emitting Laser .....	29
4.2 AlGaInAs QW 1.3-um Laser Pumped by a AQS DPSSL in Room Temperature .....	30
4.2.1 <i>The QW wafers can be gain medium in VECSEL or SESA in PQS DPSSL</i>	
4.2.2 <i>Setup and Experiment Result</i>	
4.3 VECSEL in Low-temperature System Cooled by Liquid Nitrogen .....	37
4.4 Conclusion .....	37
<i>Conclusion and Future Work</i>	
<i>Difficulties in Processing Design of SESAM and VECSEL</i>	
<b>Part B – Intracavity Nonlinear Interaction of Laser and Material without Absorption</b>	
<b>Chapter 5 – Second-order Effects .....</b>	<b>39</b>
5.1 Second-order Effects and Frequency Conversion .....	39
5.2 Noncollinear SHG, Random Scattering, Pattern Formation, and Weak Localization .....	40
5.2.1 <i>Introduction to Pattern Formation and Random Laser</i>	
5.2.2 <i>Introduction to Weak Localization and Long-range Correlation in Disordered Wave Functions from Conical SHG</i>	
5.2.3 <i>Manifestation of Weak Localization and Long-range Correlation in Disordered Wave Functions from Conical SHG</i>	
5.2.4 <i>Conclusion</i>	
5.2.5 <i>Classification of Corresponding Far-field and Near-field Pattern of Conical SHG in GdCOB and BBO crystal</i>	
5.2.6 <i>Reveal Near-field Pattern in Crystal by use of Expansion Method with Random Scattering</i>	
5.2.7 <i>Information of Crystal Property from Noncoaxial Conical SHG and Phase Matching</i>	
5.3 Optical Parametric Oscillator (OPO) .....	53
5.4 150-kW Compact Efficient Eye-safe Laser with a shared cavity configuration Pumped by Laser Diode-stack .....	53
5.4.1 <i>Experimental setup of intracavity OPO</i>	
5.4.2 <i>Experimental results</i>	
5.4.3 <i>Conclusions and Future Work</i>	
<b>Chapter 6 – Third-order Effects .....</b>	<b>63</b>
6.1 Third-order Effects and Stimulated Raman Scattering .....	63
6.2 Diode-pumped AQS Nd:YVO <sub>4</sub> Self-Raman Laser at 1176 nm and 1525 nm .....	64

6.3 Power Scale-up of the Diode-pumped AQS Nd:YVO <sub>4</sub> Raman Laser with an undoped YVO <sub>4</sub> crystal as a Raman shifter .....	65
6.4 Efficient Diode-pumped AQS Nd:YAG/BaWO <sub>4</sub> Intracavity Raman Laser .....	70
6.5 Conclusion and Future Work .....	76
<b>Chapter 7 – Summary</b> .....	<b>77</b>
7.1 Summary and Prospect .....	77
7.2 Fortuitous Coincidence? .....	79
<b>Reference</b> .....	<b>81</b>
<b>Published Journal Papers and Curriculum Vita</b> .....	<b>101</b>

