

Contents

1. Introduction	1
2. Hybrid Integrated Diode Laser Systems	3
2.1. High-Power Diode Laser Sources	4
2.2. Frequency Conversion using Periodically Poled Nonlinear Crystals	5
2.3. Occurrence of Optical Feedback	6
I. Sources of Optical Feedback	11
3. Optical Feedback of Periodically Poled Nonlinear Crystals	13
3.1. Theoretical modeling	14
3.1.1. Weakly Reflecting Bragg-Gratings	15
3.2. Investigated Periodically Poled Nonlinear Crystal Samples	23
3.2.1. Bulk Periodically Poled Nonlinear Crystals	23
3.2.2. Channel Waveguide Periodically Poled Nonlinear Crystals	24
3.3. Experimental Setup and Methods	27
3.4. Results	30
3.4.1. Optical Feedback of Bulk Periodically Poled Nonlinear Crystals	30
3.4.2. Optical Feedback of Channel Waveguide Periodically Poled Non-linear Crystals	33
3.5. Summary	39
4. Optical Feedback of Semiconductor Optical Amplifiers	41
4.1. Theoretical Modeling	42
4.1.1. Multiphysics Model	43
4.1.2. Estimation of Optical Feedback Power	47
4.2. Investigated Semiconductor Optical Amplifier Samples	49
4.2.1. Ridge Waveguide Amplifier	49
4.2.2. Tapered Amplifier	50
4.3. Experimental Setup and Methods	52
4.4. Results	53
4.4.1. Optical Feedback of Ridge Waveguide Amplifiers	54
4.4.2. Optical Feedback of Tapered Amplifiers	57
4.5. Summary	63
5. Conclusions of Part I.	65

II. Effects of Optical Feedback	67
6. Tapered Amplifiers with Optical Feedback	69
6.1. Theoretical Modeling	70
6.1.1. Model for External Optical Feedback	71
6.1.2. Model for Tapered Amplifiers	72
6.1.3. Influence of Astigmatism	73
6.2. Investigated Tapered Amplifier Sample	74
6.3. Experimental Setup and Methods	75
6.4. Results	77
6.5. Summary	85
7. Distributed Bragg-Reflector Ridge Waveguide Lasers with Optical Feedback	87
7.1. Theoretical Modeling	88
7.1.1. Lang-Kobayashi Equations	89
7.2. Investigated Laser Samples	94
7.3. Experimental Setup and Methods	95
7.4. Results	98
7.5. Summary	105
8. Conclusions of Part II.	107
9. Final Conclusions and Outlook	109
A. Additional Relations	111
A.1. Reflectance of Weak Bragg-Gratings	111
A.2. Statistical Description of Periodic Poling Errors	112
A.3. Sellmeier Equation	115
A.4. Thermal Expansion	115
A.5. Guided Modes in Channel Waveguide Periodically Poled Nonlinear Crystals	116
A.6. Computation Scheme of the Multiphysics Model	119
A.7. Calculation of the Position of the Beam Waist	127
B. Material and Simulation Parameters	131
B.1. Parameters for Periodically Poled Nonlinear Crystals	131
B.2. Parameters for Semiconductor Optical Amplifiers	133
B.3. Parameters for Distributed Bragg-Reflector Ridge Waveguide Lasers	136
C. Measurement Methods and Devices	137
C.1. Laser Sources	137
C.2. Optical Power Characterization	141
C.3. Emission Spectrum Characterization	142
C.4. Spatial Beam Characterization	142
Bibliography	145