

1	Introduction	1
1.1	Background	1
1.2	Motivation	2
1.3	Organization of the Thesis	3
2	Photorefractive Gratings: Theoretical Analysis	5
2.1	Introduction	5
2.2	Photorefractive Effect in Fe:LiNbO ₃	5
2.3	Refractive Index Modulation by Two-Beam Interference	9
2.4	Thermal Fixing and Developing	12
2.5	Grating Response: Coupled Mode Theory Analysis	14
2.6	Conclusions	18
3	Doped Waveguides: Fabrication and Characterization	19
3.1	Introduction	19
3.2	Fabrication	19
3.2.1	Er-Diffusion Doping	22
3.2.2	Fe-Diffusion Doping	23
3.2.3	Fabrication of Ti-Indiffused Waveguides	25
3.2.4	Annealing	25
3.3	Characterization	26
3.3.1	Waveguide Loss and Mode-Size	26
3.3.2	Absorption and Gain	27
3.3.3	Amplified Spontaneous Emission (ASE)	30
3.4	Conclusions	31
4	Photorefractive Gratings: Fabrication and Characterization	33
4.1	Introduction	33
4.2	Fabrication	34
4.2.1	Grating Definition	34
4.2.2	Thermal Fixing and Development of Ionic Gratings	39
4.3	Properties of Fixed Gratings	40

4.4	Conclusions	47
5	Lasers with Photorefractive Gratings	49
5.1	Introduction	49
5.2	Basic Theory of Ti:Er:LiNbO ₃ Waveguide Lasers	49
5.3	DBR-Laser with One Grating	53
5.4	DBR Laser with Two Gratings	57
5.5	DFB Laser/Amplifier	62
5.6	DFB-DBR Coupled Cavity Laser	65
5.7	Conclusions	72
6	Summary and Conclusions	73