Contents

List of Publication i

Abstract iii

1 Introduction 1

2 General theory 4

2.1 Light Propagation . . . 4
2.2 Optical Waveguide . . . 7
2.2.1 Planar Waveguide . . . 7
2.2.2 Stripe Waveguide . . . 10
2.3 Organic Semiconductor . . . 11
2.3.1 Photoluminescence Quantum Yield (PLQY) and Fluorescence Lifetime . . . 14
2.3.2 Quenching . . . 15

3 Organic Laser 16

3.1 Working Principle . . . 16
3.1.1 Amplified Spontaneous Emission (ASE) . . . 22
3.1.2 Resonator . . . 24
3.2 Distributed Feedback (DFB) Laser . . . 26
3.3 Literature Overview . . . 29

4 Experimental Methods 33

4.1 Material . . . 33
4.1.1 Poly(methyl methacrylate) (PMMA) . . . 33
4.1.2 EpoClad . . . 34
4.1.3 Dyes . . . 35
4.2 Fabrication Methods . . . 36
4.3 Measurement Methods . . . 44
4.3.1 Sample Outlook . . . 44

4.3.2 Material Characteristics 45
4.3.3 Lasing Properties 50

5 Result **53**
5.1 Sample Outlook 53
5.2 Material Characteristics of Samples Doped with Different Concentrations 57
5.3 Material Characteristics of Samples Doped with Different Dyes 62
5.4 Lasing Properties of Different Designs 69
5.4.1 Device Improvement 78
5.5 Lasing Tuning 89
5.5.1 Dye Concentration Variation 89
5.5.2 Grating Period Variation 94
5.5.3 Dye Variation 99
5.5.4 Application Potential 108

6 Conclusion **112**

Acknowledgements **115**

Abbreviations **117**

List of Figures **119**

Bibliography **124**