Contents

Zusammenfassung				
1	Introdu	Introduction		
2	An introduction to amorphous organic semiconductors		6	
	2.1 Structural properties of organic materials		6	
	2.2 Fu	ndamental principles of energy and charge transfer	9	
2.2.1 Pho 2.2.2 Tra		Photophysical processes in organic light-emitting materials	10	
		Transport phenomena in amorphous organic semiconductors	13	
	2.3 OI	ED device operation	17	
2.4 Lasi		sing in organic semiconductors	18	
	2.4.1	Stimulated emission	18	
2.4.2		Amplified spontaneous emission (ASE)	19	
	2.4.3 Laser resonators			
2	3 Materials and technology		20	
3	Materia	as and technology	29	
3	3.1 Or	ganic semiconductor materials	29 29	
3	3.1 Or 3.1.1	ganic semiconductor materials Electron-transport materials	29 29 29	
3	3.1 Or 3.1.1 3.1.2	ganic semiconductor materials Electron-transport materials Hole-transport materials	29 29 29 31	
3	3.1 Or 3.1.1 3.1.2 3.1.3	ganic semiconductor materials Electron-transport materials Hole-transport materials Emitter materials suitable for lasing	29 29 29 31 33	
3	3.1 Or 3.1.1 3.1.2 3.1.3 3.2 Fa	ganic semiconductor materials Electron-transport materials Hole-transport materials Emitter materials suitable for lasing brication of organic LEDs and laser diode structures	29 29 31 33 39	
3	3.1 Or 3.1.1 3.1.2 3.1.3 3.2 Fa 3.2.1	ganic semiconductor materials Electron-transport materials Hole-transport materials Emitter materials suitable for lasing brication of organic LEDs and laser diode structures Deposition methods	29 29 31 33 39 39	
3	3.1 Or 3.1.1 3.1.2 3.1.3 3.2 Fa 3.2.1 3.2.2	ganic semiconductor materials Electron-transport materials Hole-transport materials Emitter materials suitable for lasing brication of organic LEDs and laser diode structures Deposition methods Photocrosslinked multilayer devices	29 29 31 33 39 39 40	
3	3.1 Or 3.1.1 3.1.2 3.1.3 3.2 Fa 3.2.1 3.2.2 3.2.3	ganic semiconductor materials Electron-transport materials Hole-transport materials Emitter materials suitable for lasing brication of organic LEDs and laser diode structures Deposition methods Photocrosslinked multilayer devices Small-area devices	29 29 31 33 39 39 40 42	
4	3.1 Or 3.1.1 3.1.2 3.1.3 3.2 Fa 3.2.1 3.2.2 3.2.3 Optical	ganic semiconductor materials Electron-transport materials Hole-transport materials Emitter materials suitable for lasing brication of organic LEDs and laser diode structures Deposition methods Photocrosslinked multilayer devices Small-area devices Iy pumped organic distributed feedback lasers	29 29 31 33 39 39 40 42 43	
4	3.1 Or 3.1.1 3.1.2 3.1.3 3.2 Fa 3.2.1 3.2.2 3.2.3 Optical 4.1 Exp	ganic semiconductor materials Electron-transport materials Hole-transport materials Emitter materials suitable for lasing brication of organic LEDs and laser diode structures Deposition methods Photocrosslinked multilayer devices Small-area devices Iy pumped organic distributed feedback lasers	29 29 31 33 39 39 40 42 43 43	
4	3.1 Or 3.1.1 3.1.2 3.1.3 3.2 Fa 3.2.1 3.2.2 3.2.3 Optical 4.1 Ex 4.2 Fin	ganic semiconductor materials Electron-transport materials Hole-transport materials Emitter materials suitable for lasing brication of organic LEDs and laser diode structures Deposition methods Photocrosslinked multilayer devices Small-area devices Ity pumped organic distributed feedback lasers perimental setup est- and second-order DFB lasers	29 29 31 33 39 39 40 42 43 43 44	

4.4	Indirect electrical pumping	51
4.4.1	Setup	52
4.4.2	Results	55
5 Towa	ards an organic injection laser	61
5.1	Numerical simulations	61
5.1.1	Waveguiding properties	63
5.1.2	Gain and loss processes	64
5.2	Design Rules	68
5.2.1	Emission wavelength	68
5.2.2	Device geometry	69
5.2.3	Influence of annihilation processes on device performance	72
5.2.4	Reducing the influence of current induced loss processes	75
5.3	Waveguide attenuation in organic multilayer laser structures suitable	e for
electrica	al injection	78
5.3.1	Experimental setup for waveguide attenuation measurements	78
5.3.2	Transparent conductive oxides (TCOs) as electrode materials	82
5.3.3	Fully contacted multilayer structures	86
5.4	High current density excitation	89
5.4.1	Device failure mechanisms	89
5.4.2	Photocrosslinked hole-transport QUPD devices	92
6 Conc	lusions and outlook	99
Acknowle	dgement	102
Appendix		
Abbreviat	tions	111
Bibliogra	ohy	114