

Table of Contents

1	Introduction	1
1.1	Organic Electronics.....	1
1.2	Scope of thesis	4
1.3	Structure of thesis	6
2	Theoretical Background	9
2.1	Polymers	9
2.1.1	Polymer structure	9
2.1.2	Electrical properties of polymers	13
2.2	Conducting polymers	17
2.2.1	Conjugated systems	17
2.2.2	Charge transport in conjugated polymers	19
2.2.3	Organic semiconductors.....	22
2.3	OFET Technology.....	23
2.3.1	Organic field-effect transistors.....	23
2.3.2	Operating principles and parameter extraction	25
2.3.3	Solution-processed OFETs: P3HT	28
2.4	Gate Insulators in Organic Field-Effect Transistors.....	32
2.4.1	Literature Survey: Organic gate insulators	33
2.4.2	Interface engineering in OFETs	40
2.4.3	Ferroelectric functionalized OFETs	42
2.4.4	Literature Survey: Non-volatile OFET memory elements with high- k gate insulators	43
3	Hybrid Organic Field-Effect Transistors.....	47
3.1	Materials and Methods	48
3.1.1	Silicon wafers and electrodes.....	48
3.1.2	HMDS priming of wafers and contact angle measurements	49
3.1.3	Solution-Processing of P3HT	51
3.1.4	Measurement and evaluation of transistors	52
3.2	Production and Characterization of Hybrid Transistors	52
3.2.1	Effect of dielectric-semiconductor interface: HMDS-coating	53
3.2.2	Effects of annealing time of semiconductor.....	56
3.2.3	Effects of high boiling point solvents for P3HT	58
3.2.4	Interaction of P3HT transistors with atmosphere	60

3.2.5 Effects of device configuration	63
3.2.6 Effects of semiconductor purity	65
3.3 Conclusion	67
4 Organic Transistors with Polymer Dielectrics	69
4.1 Dielectric materials for bottom-gate organic transistors	69
4.1.1 Constraints for materials selection and candidate materials.....	69
4.1.2 Processing of dielectric films and surface properties	74
4.1.3 Dielectric properties of selected materials.....	79
4.1.4 Metal-insulator-semiconductor devices	82
4.2 OFETs with polymer dielectrics	83
4.2.1 Production and characterization of bottom-gate OFETs	83
4.2.2 Comparison of devices with different semiconductors	86
4.2.3 All-organic transistors with NOA74 by laser structuring	91
4.3 Conclusion	94
5 Solution-processed nanocomposite gate insulator for low driving-voltages and ferroelectric memory effect.....	97
5.1 Materials and methods	98
5.2 Optical and surface characterization of pure and composite films	100
5.3 Determination of dielectric properties of pure and composite layers.....	101
5.4 Ferroelectric functionalized OFETs: Device characterization.....	103
5.5 Conclusion	106
6 Conclusions and Outlook.....	107
6.1 Conclusions	107
6.2 Outlook.....	110
Bibliography.....	113
List of Abbreviations.....	121
List of Publications	125

