

Contents

1	Organic molecules for information processing	5
1.1	Perspectives, applications and present status	5
1.2	Self-assembled monolayers	7
1.3	Outline of the thesis	9
1.3.1	Substrates	10
1.3.2	Construction of a new UHV system	10
1.3.3	Self-assembled monolayers of alkanethiols	10
1.3.4	Structural and electrical properties of ferrocenes	10
1.3.5	Self-assembled monolayers of carboxylates on copper	11
2	Charge transfer on the nanoscale	12
2.1	Types of junctions	12
2.2	Charge transfer in general	13
2.3	Tunneling through a molecular device	15
2.4	Conduction through a molecular device	17
3	Scanning Probe Microscopy	19
3.1	Scanning tunneling microscopy	21
3.2	Scanning tunneling spectroscopy	24
4	Construction of a new UHV-STM System	27
4.1	Motivation and concept	28
4.2	Setup	29
4.2.1	Sputter cleaning and load lock	29
4.2.2	Vapor deposition chamber	30
4.2.3	Storage chamber	32
4.2.4	Measurement chamber	33
4.3	Sample and tip carriers	34
4.3.1	Tip carrier	34
4.3.2	Heating carrier	35

5	Substrates	37
5.1	Gold thin film substrates	37
5.2	Copper (110) single crystal substrates	43
6	Self-Assembled Monolayers of Alkanethiols on Au(111)	51
6.1	Introduction	51
6.2	Experimental	57
6.3	A new $c(4\times 2)$ -superlattice, the ζ -phase	57
6.4	Intermediate $(3\times 2\sqrt{3})$ -phase	62
6.5	Domain boundaries	66
6.6	Spectroscopy	70
6.7	Conclusion	71
7	Structural and Electrical Properties of Ferrocenes	73
7.1	The matrix isolation approach	74
7.2	Structural properties	76
7.3	Ferrocene derivatives	77
7.4	Experimental	78
7.5	Ferrocene self-assembled monolayers	79
7.5.1	Dithiobis-ferrocenes	79
7.5.2	Mercaptoalkyl-ferrocenes	80
7.6	Mixed monolayers	89
7.6.1	Insertion vs. coadsorption	90
7.6.2	Phase-separated islands	93
7.6.3	Ordered islands	96
7.6.4	Voltage dependent features	98
7.6.5	Embedded single molecules	100
7.6.6	New hybrid structures	101
7.6.7	Layer stability	104
7.7	Spectroscopy	105
7.7.1	Current-decay parameters	105
7.7.2	Voltage dependent behavior of the ferrocene moiety	108
7.8	Conclusion	113
8	Carboxylic Acids on Cu(110)	116
8.1	Experimental	118
8.2	Benzoic acid	118
8.2.1	Thermal annealing	119
8.2.2	New close-packed structure	120
8.3	Terephthalic acid	124

8.3.1	First topography scans	126
8.4	Conclusion	127
9	Conclusion	128
9.1	Substrates	128
9.2	Construction of a new experimental UHV system	129
9.3	Self-assembled monolayers of alkanethiols	129
9.4	Structural and electrical properties of ferrocenes	130
9.5	Self-assembled monolayers of carboxylates on copper	131
9.6	Perspectives	131
	Nomenclature	133
	Bibliography	134