



Stefan Graber (Autor)

**From STM to LEECs: Syntheses and Applications of
Multifunctional Bipyridine Ligands and their Iridium
(III) Complexes**

From STM to LEECs:
Syntheses and Applications of
Multifunctional Bipyridine Ligands
and their Iridium(III) Complexes

Stefan Graber



Cuvillier Verlag Göttingen
Internationaler wissenschaftlicher Fachverlag

<https://cuvillier.de/de/shop/publications/980>

Copyright:

Cuvillier Verlag, Inhaberin Annette Jentzsch-Cuvillier, Nonnenstieg 8, 37075 Göttingen,
Germany

Telefon: +49 (0)551 54724-0, E-Mail: info@cuvillier.de, Website: <https://cuvillier.de>

Contents

Acknowledgments.....	iii
Contents.....	vi
Abbreviations.....	ix
Abstract.....	xiii
Chapter 1 Background.....	1
1.1 Supramolecular chemistry.....	2
1.1.1 History and terminology.....	2
1.1.2 Weak chemical bonds.....	3
1.1.2.1 Hydrogen bonding.....	3
1.1.2.2 π-π Interactions.....	4
1.1.3 Self-assembly.....	6
1.2 Dendrimers.....	7
1.2.1 History and terminology.....	7
1.2.2 Construction of dendrimers.....	7
1.2.3 Fréchet-type dendrimers.....	10
1.3 Coordination chemistry.....	11
1.3.1 History and concepts.....	11
1.3.2 Oligopyridines.....	13
1.3.3 Iridium and its complexes.....	13
1.4 Scanning tunnelling microscopy.....	15
1.4.1 History.....	15
1.4.2 Concept.....	16
1.5 Solid state lighting.....	18
1.5.1 History and terminology.....	18
1.5.2 General principles of electroluminescence.....	19
1.5.3 OLEDs and LEECs.....	20
Chapter 2 Instruments and Methods.....	25
2.1 General experimental.....	26
2.2 Analytical equipment.....	27

2.3	Scanning tunnelling microscopy.....	29
2.3.1	Setup.....	29
2.3.2	Processing images.....	33
2.3.3	Assigning and overlaying molecules.....	34
2.4	LEEC devices.....	35
Chapter 3	Synthesis and STM Imaging of Achiral and Chiral Dendrons.....	37
3.1	Introduction and aims.....	38
3.2	Synthesis and discussion.....	39
3.2.1	Achiral dendrons.....	39
3.2.2	Chiral dendrons.....	40
3.2.3	Second generation dendrons.....	42
3.2.4	Dendrons with different chain lengths.....	43
3.3	STM imaging and discussion.....	44
3.4	Experimental part.....	52
Chapter 4	Synthesis and STM Imaging of Achiral and Chiral Bipyridine Ligands.....	59
4.1	Introduction and aims.....	60
4.2	Synthesis and discussion.....	62
4.2.1	Achiral ligands.....	62
4.2.2	Chiral ligands.....	63
4.2.3	Second generation ligands.....	68
4.2.4	Ligands with different chain lengths.....	69
4.3	STM imaging and discussion.....	70
4.3.1	Air/solid-interface.....	71
4.3.2	Liquid/solid-interface.....	74
4.4	Experimental part.....	79
Chapter 5	Synthesis and STM Imaging of Perfluorinated Dendrons and Ligands.....	87
5.1	Introduction and aims.....	88
5.2	Synthesis and discussion.....	88
5.2.1	Dendron synthesis.....	88
5.2.2	Ligand synthesis.....	92
5.3	STM imaging and discussion.....	94
5.4	Experimental part.....	96
Chapter 6	Synthesis and STM Imaging of Ligands for Iridium(III) Complexes.....	101
6.1	Introduction and aims.....	102
6.2	Synthesis and discussion.....	103
6.2.1	Simple ligands.....	103

6.2.2	Dendronised ligands.....	.110
6.3	STM imaging and discussion.....	.114
6.4	Experimental part.....	.116
Chapter 7	Synthesis and STM Imaging of Cyclometallated Iridium(III) Complexes.....	.123
7.1	Introduction and aims.....	.124
7.2	Synthesis and discussion.....	.125
7.2.1	Cyclometallated Ir(III) dimers.....	.125
7.2.2	Cyclometallated Ir(III) complexes.....	.128
7.2.2.1	Ir(III) complexes with different <i>N,N'</i> -ligands.....	.129
7.2.2.2	Ir(III) complexes with different <i>C,N</i> -ligands.....	.132
7.3	Characterisation of the Cyclometallated Ir(III) complexes.....	.134
7.3.1	General characterisation.....	.134
7.3.2	UV-Vis absorption.....	.135
7.3.3	Photoluminescence and lifetime.....	.140
7.3.4	Cyclic voltammetry.....	.144
7.3.5	Crystal structures.....	.146
7.4	STM imaging of the cyclometallated Ir(III) complexes and discussion.....	.160
7.5	Experimental part.....	.163
Chapter 8	Light-Emitting Electrochemical Cells.....	.175
8.1	Introduction and aims.....	.176
8.2	Device performance and discussion.....	.179
8.2.1	Phenanthroline based complexes.....	.179
8.2.2	Simple bipyridine based complexes.....	.180
8.2.3	Archetype and dendronised based complexes.....	.181
8.2.4	Modified phenyl-pyridine based complexes.....	.183
8.2.5	Pyrazole based complexes.....	.184
8.3	Conclusions.....	.185
Appendix A: References.....	.187	
Appendix B: Crystal structure data.....	.196	