

University of Groningen

Liquid crystals as amplifiers of molecular chirality

Eelkema, Rienk

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version

Publisher's PDF, also known as Version of record

Publication date:

2006

[Link to publication in University of Groningen/UMCG research database](#)

Citation for published version (APA):

Eelkema, R. (2006). Liquid crystals as amplifiers of molecular chirality s.n.

Copyright

Other than for strictly personal use, it is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license (like Creative Commons).

Take-down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Downloaded from the University of Groningen/UMCG research database (Pure): <http://www.rug.nl/research/portal>. For technical reasons the number of authors shown on this cover page is limited to 10 maximum.

Liquid Crystals as Amplifiers of Molecular Chirality

Rienk Eelkema



The work described in this thesis was carried out at the Department of Organic and Molecular Inorganic Chemistry, the Stratingh Institute for Chemistry, University of Groningen, The Netherlands.



The work described in this thesis was financially supported by the Netherlands Organization for Scientific Research (NWO).

Druk: Wöhrmann Print Service

RIJKSUNIVERSITEIT GRONINGEN

Liquid Crystals as Amplifiers of Molecular Chirality

Proefschrift

ter verkrijging van het doctoraat in de
Wiskunde en Natuurwetenschappen
aan de Rijksuniversiteit Groningen
op gezag van de
Rector Magnificus, dr. F. Zwarts,
in het openbaar te verdedigen op
maandag 24 april 2006
om 16.15 uur

door

Rienk Eelkema

geboren op 22 augustus 1978
te Bilthoven

Promotor: Prof. Dr. B. L. Feringa

Beoordelingscommissie: Prof. Dr. D. J. Broer
Prof. Dr. J. B. F. N. Engberts
Prof. Dr. R. J. M. Nolte

ISBN: 90-367-2570-4

Contents

Chapter 1	Introduction	
1.1	General Introduction	1
1.2	Amplification of Chirality	2
1.3	Liquid Crystals	2
1.4	Aims and Outline of this Thesis	2
1.5	References and Notes	3
Chapter 2	On the Chirality of Doped Liquid Crystals	
2.1	Introduction to Liquid Crystal Phases	6
2.2	Chirality in Liquid Crystals	10
2.3	Liquid Crystal Phases, Structures and Textures	14
2.4	Dopants	17
2.5	Conclusions	42
2.6	References and Notes	43
Chapter 3	Enantioselectivity Determinations using Liquid Crystalline Media	
3.1	Introduction	50
3.2	New Methods for Determination of Enantioselectivity	50
3.3	Synthesis of New Reaction Substrates and Their Performance in Catalytic 1,4-Additions	58
3.4	Application of 1,4-Addition Products in an LC-Based Color Test	62
3.5	Enantiomeric Excess Determination using Auxiliary Chiral Dopants	67
3.6	Conclusion and Discussion	69
3.7	Experimental Section	70
3.8	References and Notes	79
Chapter 4	A Biphenol-Based Receptor for Amplification of Molecular Chirality	
4.1	Introduction	84
4.2	Color Indicators of Molecular Chirality Based on Noncovalent Interactions	84
4.3	Double Amplification via Hydrogen Bonding	86
4.4	Results	88
4.5	Solution Structure of a Biphenol-Amino Alcohol Complex	106
4.6	Conclusions	112
4.7	Experimental Section	113
4.8	References and Notes	131

Chapter 5	A Phosphoric Acid-Based Receptor for Amplification of Molecular Chirality	
5.1	Introduction	136
5.2	Phosphoric Acids as Receptors for Amplification of Chirality	137
5.3	Characterization of the Solution Structure of Host-Guest Complexes	141
5.4	Conclusions	145
5.5	Experimental Section	146
5.6	References and Notes	149
Chapter 6	Reversible Control of the Chirality and Color of Cholesteric Liquid Crystals	
6.1	Introduction	152
6.2	Photocontrol of Colored Liquid Crystalline Phases	152
6.3	Design of a New Molecular Motor for Switching in the Liquid Crystalline Matrix	156
6.4	Isotropic Solution Behavior of Fluorene-Based Motors	157
6.5	Molecular Motors in Liquid Crystalline Environments	159
6.6	Reversible LC Color Tuning using a Molecular Motor	165
6.7	Conclusions and Discussion	167
6.8	Experimental Section	167
6.9	References and Notes	169
Chapter 7	Rotation of Microscopic Objects with a Light-Driven Molecular Motor	
7.1	Introduction	174
7.2	Biological Molecular Motors	174
7.3	Movement by Synthetic Molecular Machinery	176
7.4	Rotational Reorganization of a Cholesteric Liquid Crystalline Film	178
7.5	Rotating Particles	188
7.6	Surface Characteristics of Cholesteric Films	194
7.7	Conclusions and Discussion	199
7.8	Experimental Section	199
7.9	References and Notes	202
Samenvatting		207
Dankwoord		215