



Universiteit
Leiden
The Netherlands

Copper trispyrazolylborate complexes for ethene detection

Dijkman, T.F. van

Citation

Dijkman, T. F. van. (2016, May 12). *Copper trispyrazolylborate complexes for ethene detection*. Retrieved from <https://hdl.handle.net/1887/39518>

Version: Not Applicable (or Unknown)

License: [Licence agreement concerning inclusion of doctoral thesis in the Institutional Repository of the University of Leiden](#)

Downloaded from: <https://hdl.handle.net/1887/39518>

Note: To cite this publication please use the final published version (if applicable).

Cover Page



Universiteit Leiden



The handle <http://hdl.handle.net/1887/39518> holds various files of this Leiden University dissertation.

Author: Dijkman, T.F. van

Title: Copper trispyrazolylborate complexes for ethene detection

Issue Date: 2016-05-12

Copper trispyrazolylborate complexes for ethene detection

PROEFSCHRIFT

Ter verkrijging van
de graad van Doctor aan de Universiteit Leiden,
op gezag van de Rector Magnificus Prof. mr. C. J. J. M. Stolker,
volgens besluit van het College voor Promoties
te verdedigen op donderdag 12 mei 2016
klokke 13.45 uur

door

Thomas Frederik van Dijkman

Geboren te Rotterdam in 1987

Samenstelling Pomotiecommissie

Promotor	Prof. dr. E. Bouwman
Co-promotor	dr. S. Bonnet
Overige leden	Prof. dr. J. Brouwer (Universiteit Leiden) Prof. dr. G.A. van der Marel (Universiteit Leiden) Prof. dr. J.G. Roelfes (Rijksuniversiteit Groningen) Prof. dr. C. Pettinari (Università di Camerino, Italy)

This work has been financially supported by NanoNextNL, a micro and nanotechnology consortium of the Government of the Netherlands and 130 partners.

Printed by Ridderprint B.V. with financial support from EMS B.V.

Table of Contents

Chapters

1.	Introduction. Ethene, why it is important, its role in nature and how it is detected.....	7
2.	Bright cyan phosphorescence of a phosphane copper(I) complex of the trihydridopyrazolylborate ligand [H ₃ B(3,5-Ph ₂ pz)] ⁻	29
3.	Copper(I) complexes of naphthyl-substituted fluorinated trispyrazolylborate ligands with ethene and carbon monoxide	47
4.	Extremely bulky copper(I) complexes of [HB(3,5-{1-naphthyl} ₂ pz) ₃] ⁻ and [HB(3,5-{2-naphthyl} ₂ pz) ₃] ⁻ and their self-assembly on graphene.	69
5.	Highly tunable fluorinated trispyrazolylborates [HB(3-CF ₃ -5-{4-RPh}pz) ₃] ⁻ (R = NO ₂ , CF ₃ , Cl, F, H, OMe and NMe ₂) and their copper(I) complexes.....	99
6.	Ultra-sensitive ethene detection on graphene field effect transistors using copper(I) scorpionate complexes.....	133
7.	Summary, Conclusions and Outlook	169

Appendices

I.	Risk Analysis and Technology Assessment.....	179
II.	Supplementary information for Chapter 2.....	187
III.	Supplementary information for Chapter 3.....	191
IV.	Supplementary information for Chapter 4.....	193
V.	Supplementary information for Chapter 5.....	195
VI.	Supplementary information for Chapter 6.....	199
	Samenvatting.....	213
	List of publications	221
	Curriculum Vitae	223

List of Abbreviations

(v)w	(very) weak
Ac	acetyl
ALD	atomic layer deposition
atm	atmosphere (1 atm = 101325 Pa)
bs	broad singlet
Bu	butyl
d	doublet
DCM	dichloromethane
DFT	density functional theory
DMI	1,3-dimethyl-2-imidazolidinone
DMPU	1,3-dimethylpropyleneurea
ESI	electrospray ionization
Et	ethyl
His	histidine
hr	hours
IR	infrared
<i>J</i>	coupling constant
LMCT	ligand-to-metal charge transfer
m	multiplet (NMR), medium (IR)
Me	methyl
min	minutes
MLCT	metal-to-ligand charge transfer
Ms	mesityl
Ph	phenyl
ppb	parts per billion
ppm	parts per million
ppt	parts per trillion
Pr	propyl
pz	pyrazolyl
q	quartet
RT	room temperature
s	singlet
t	triplet
THF	tetrahydrofuran
TP	trispyrazolylborate
Tpm	trispyrazolylmethane
tz	triazolyl