



Universiteit
Leiden
The Netherlands

Ln(III) complexes as potential phosphors for white LEDs

Akerboom, S.

Citation

Akerboom, S. (2013, October 29). *Ln(III) complexes as potential phosphors for white LEDs*. Retrieved from <https://hdl.handle.net/1887/22054>

Version: Not Applicable (or Unknown)

License: [Leiden University Non-exclusive license](#)

Downloaded from: <https://hdl.handle.net/1887/22054>

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

Cover Page



Universiteit Leiden



The handle <http://hdl.handle.net/1887/22054> holds various files of this Leiden University dissertation.

Author: Akerboom, Sebastiaan

Title: Ln(III) complexes as potential phosphors for white LEDs

Issue Date: 2013-10-29

Ln(III) complexes as potential phosphors for white LEDs

PROEFSCHRIFT

Ter verkrijging van
de graad van Doctor aan de Universiteit Leiden,
op gezag van Rector Magnificus prof. mr. C.J.J.M. Stolker,
volgens besluit van het College voor Promoties
te verdedigen op dinsdag 29 oktober 2013
klokke 10:00 uur

door

Sebastiaan Akerboom

geboren te 's Gravenhage, Nederland in 1985

Samenstelling promotiecommissie

Promotor Prof. Dr. E. Bouwman

Co-promotor Dr. W.T. Fu

Overige leden Prof. Dr. M.A.G.J. Orrit

Prof. Dr. A. Meijerink (Universiteit Utrecht)

Prof. Dr. C. Wickleder (Universität Siegen)

Prof. Dr. J. Brouwer

“Unless someone discovers a means of making
luminescent bodies that are vastly brighter than the best
known, luminescence may be excluded altogether as a
factor in artificial lighting.”

(E.L. Nichols, Trans. I.E.S. **16**, 332, 1921)

aan mijn ouders

Table of Contents

1. Introduction	7
2. Substituted phenanthrolines as antennae in luminescent Eu(III) complexes	47
3. Ln(III) complexes with small aromatic ligands	71
4. Phenol-type ligands as sensitizers	87
5. Tuning Eu(III) complexes with dibenzoylmethanates	109
6. Triboluminescence of lanthanoid dibenzoylmethanates	129
7. Summary, general discussion and outlook	143
8. Appendix A, Quantum yield determination	151
Samenvatting	158
List of Publications	162
Curriculum vitae	163
Acknowledgements	164

List of abbreviations

CCT	Correlated color temperature
CIE	Commission Internationale de l'Eclairage (French)
CFL	Compact Fluorescent Lamp
Cgs	centimeter-gram-second (system of units)
CRI	Color Rendering Index
CRT	Cathode Ray Tube
CT	Charge transfer
dmf	N,N-dimethylformamide
dmsO	dimethyl sulfoxide
ED	Electric dipole
ET	Energy transfer
EU-27	European Union (27 member states)
H ₂ fda	Furan-2,5-dicarboxylic acid
H ₄ tma	4-hydroxy trimesic acid
Hdbm	Dibenzoylmethane
IR	Infrared
ISC	Intersystem crossing
IUPAC	International Union of Pure and Applied Chemistry
JO theory	Judd-Ofelt theory
LED	Light-emitting diode
Lm	Lumen
LMCT	Ligand-to-metal charge transfer
MD	Magnetic dipole
MOF	Metal Organic Framework
Mtoe	Million tonnes of oil equivalent
nIR	Near infrared
nUV	Near ultraviolet
PC-WLED	Phosphor-converted white LED
PDP	Plasma Display Panel
PWh	Petawatt-hours (= 10 ¹⁵ Watt-hours)
PL	Photoluminescence
PLQY	Photoluminescence quantum yield
ppm	Parts per million
SI	Système internationale (French)
SSL	Solid State Lighting
TACN	1,4,7-Triaza-cyclononane
TL	Tube Luminescent (French)
TrL	Triboluminescence
TWh	Terawatt-hours (= 10 ¹² Watt-hours)
UV	Ultraviolet
VUV	Vacuum ultraviolet
YAG	Yttrium-aluminum garnet