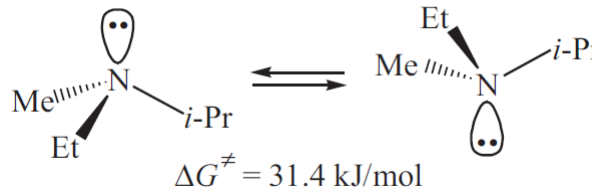
Stereodynamic System
Stereolabile chiral compounds

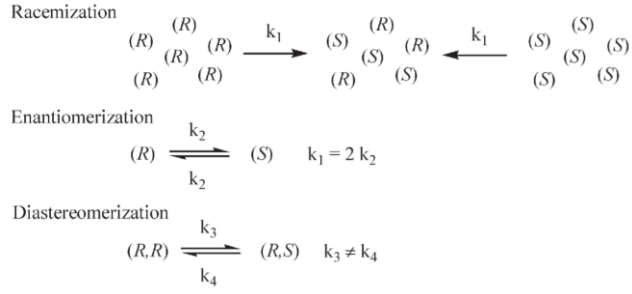
C. Wolf Chem. Soc. Rev. 2005, 34, 595
C. Wolf Chem. Soc. Rev., 2013,42, 5408

Dynamic stereochemistry deals with the three-dimensional structure of interconverting conformational or configurational isomers as a function of time. The determination of isomerization kinetics, i.e. rate constants and activation parameters ($\Delta G^{\ddagger}$, $\Delta H^{\ddagger}$, $\Delta S^{\ddagger}$), therefore plays a crucial role in the study of stereolabile compounds and is routinely performed using either spectroscopic, chiroptical or chromatographic techniques.



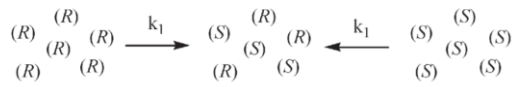
$\Delta G^{\neq} = 31.4$ kJ/mol

Interconversion processes of conformationally or configurationally unstable chiral molecules can be treated macroscopically as a change toward a racemic (interconversion of enantiomers) or non-racemic (interconversion of diastereoisomers) mixture of stereoisomers at thermodynamic equilibrium or they can be analyzed microscopically, i.e. on the molecular level. The former approach discusses an irreversible process, whereas the latter can, in principle, provide individual rate constants for each interconversion reaction thus including reversibility

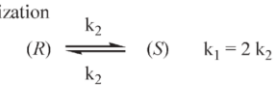


Monitoring the change in the optical rotation or circular dichroism of a chiral non-racemic mixture will provide the rate of racemization, while other methods such as dynamic chromatography afford enantiomerization rates. Although enantiomerization and racemization kinetics can be used to describe the same process it is important to distinguish between the two mathematical treatments and the corresponding different rate constants kenant and krac.

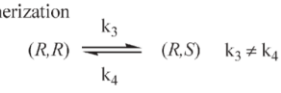
Racemization



Enantiomerization

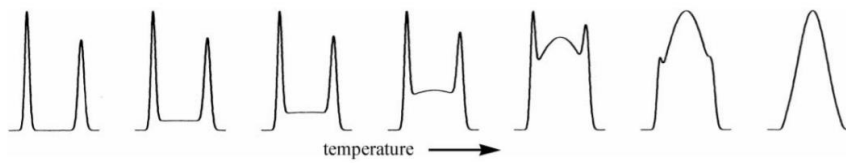


Diastereomerization

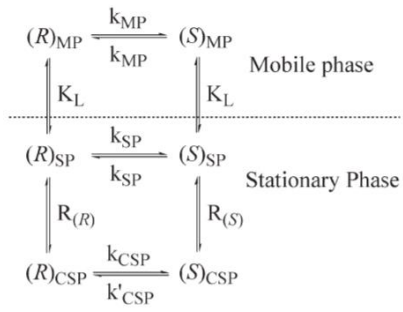


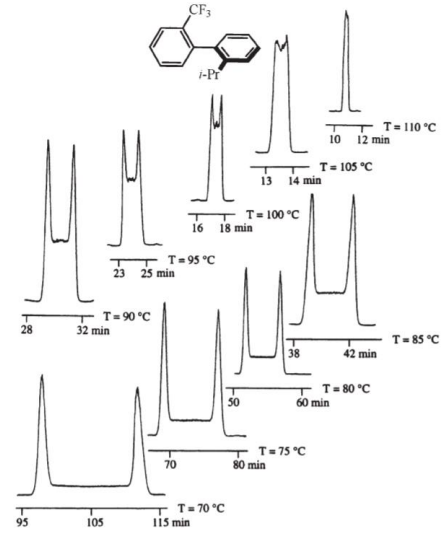
Dynamic Chromatography

A successful chromatographic separation of stereoisomers affords two distinct peaks. However, stereoisomers may undergo interconversion during the chromatographic process at elevated temperatures. The competition between resolution and isomerization results in an elution profile showing a plateau between the peaks. The plateau formation is a consequence of on-column isomerization which increases with temperature.



Chiral GC





Simulation Dynamic Chromatography

A successful chromatographic separa distinct peaks. However, stereoisom during the chromatographic process competition between resolution and i profile showing a plateau between th a consequence of on-column isom temperature.

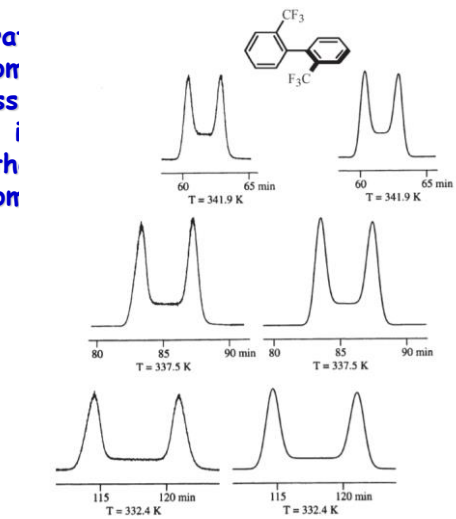
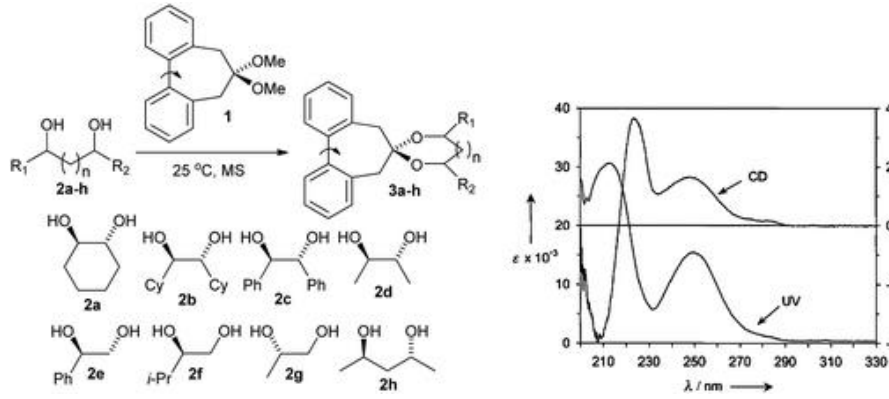


Fig. 5 Comparison of experimentally obtained (left) and simulated chromatograms (right) of 2,2′-bistrifluoromethylbiphenyl.

StereoDynamic CD Sensor

Many important chiral compounds cannot be directly investigated by electronic CDspectroscopy because they lack a strong chromophoric group and therefore produce none or only negligible Cotton effects in the UV region.



StereoDynamic CD Sensor

(1) The sensor should be readily available, effective in stoichiometric amounts, recyclable and applicable to a wide range of substrates.

(2) The molecular recognition and asymmetric induction process should be fast and allow time-efficient in situ CD measurements without the need for elaborate purification steps.

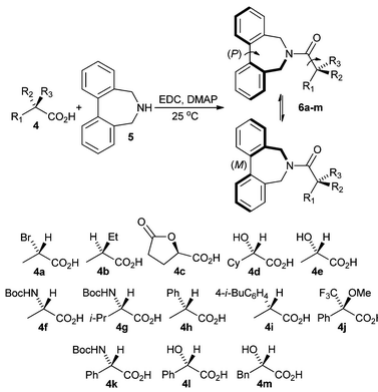
(3) The sensor should produce intense Cotton effects at high wavelengths to reduce interference with CD active impurities or catalysts that might be present when asymmetric reactions are screened.

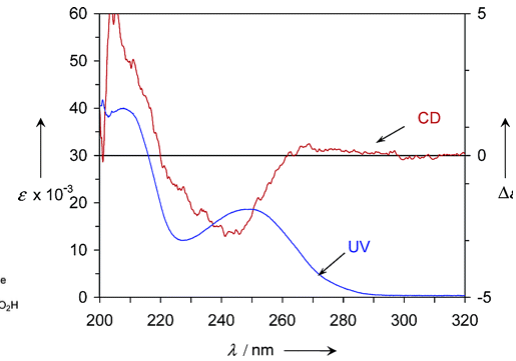
(4) A strong CD output is a general requisite for accurate ee determination and reduces the consumption of sample and sensor.

(5) The sensor should provide reliable information about the absolute configuration of a large number of substrates that is based on well-defined molecular interactions and a consistent chiral induction outcome.

StereoDynamic CD Sensor should provide reliable information about the absolute configuration.

Rosini biphenyl-derived azepine probe.





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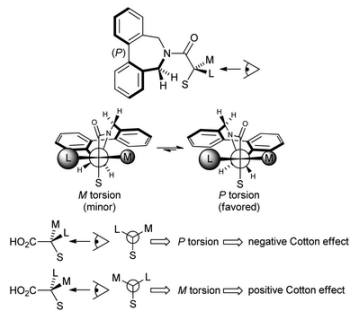
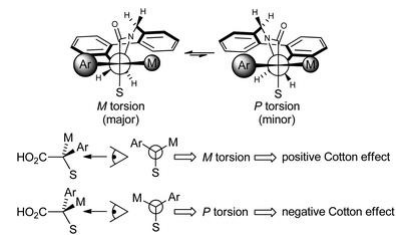
StereoDynamic CD Sensor should provide reliable information about the absolute configuration.

Rosini biphenyl-derived azepine probe.
Chiral induction model for 2-alkyl-substituted carboxylic acids.





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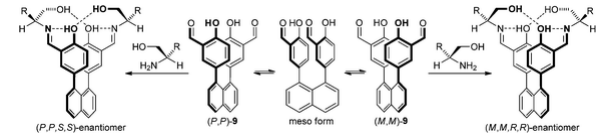
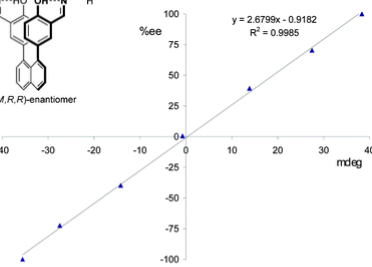
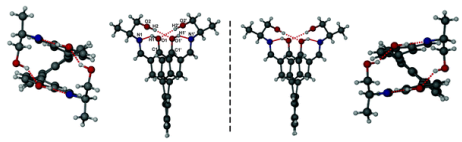
StereoDynamic CD
Wolf triaryl system.

Systems carrying two cofacial salicylaldehyde rings connected to the peri-positions of naphthalene. At room temperature, the C2-symmetric anti-rotamers rapidly interconvert via the less stable meso form and the racemic mixture is CD silent.

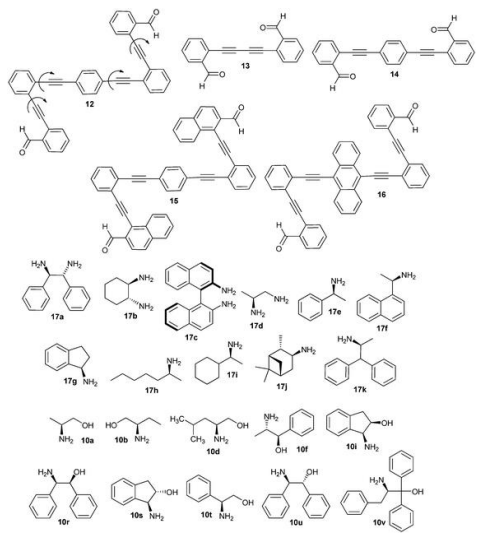


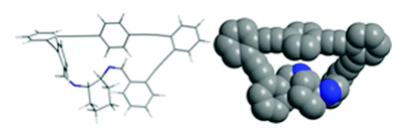




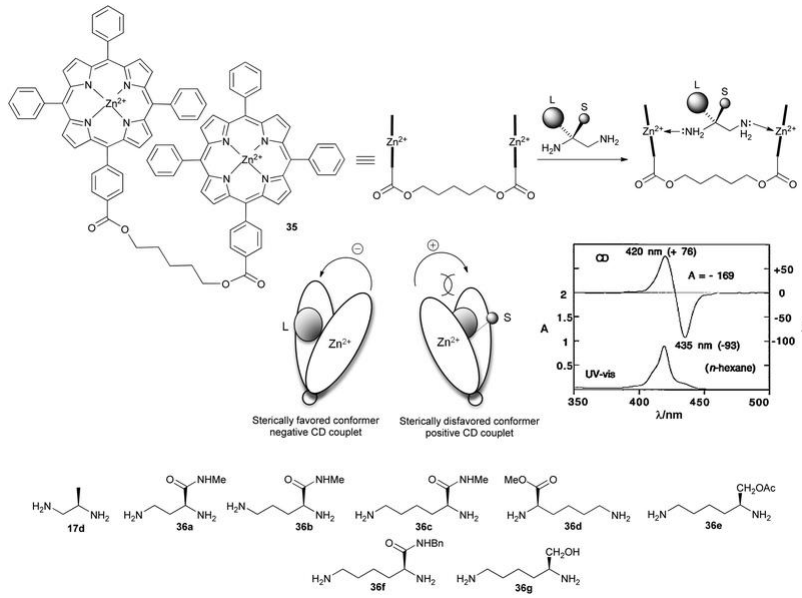
Actual %ee (*R*)	Calculated %ee (*R*)
74.9	77.0
-67.8	-64.2
36.4	36.9
-23.1	-22.5
89.1	92.9
-82.6	-81.7

StereoDynamic
Wolf stereodynamic arylacetylene framework and two peripheral benzaldehyde moieties





StereoDynamic CD Sensor
Nakanishi, Berova Porphyrins



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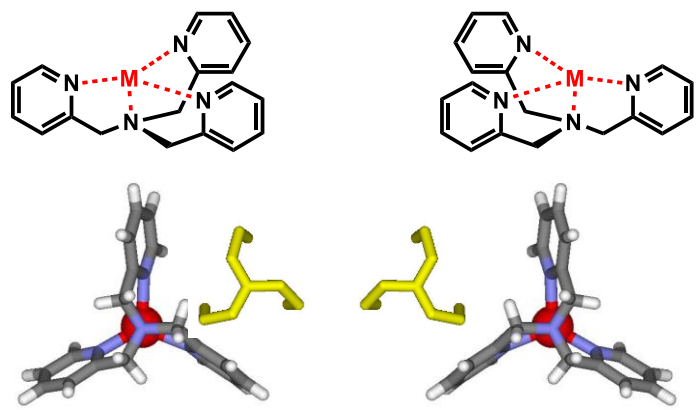
Tris-Pyridylmethyl Amines and Chirality



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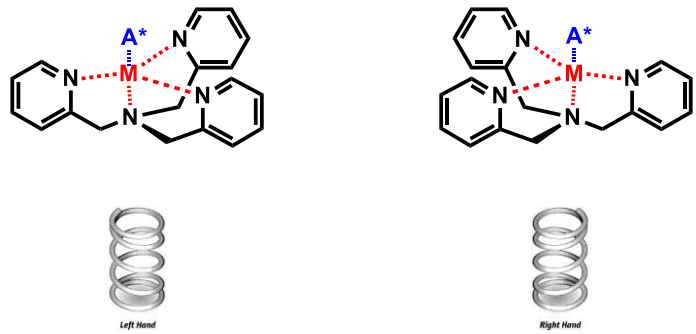
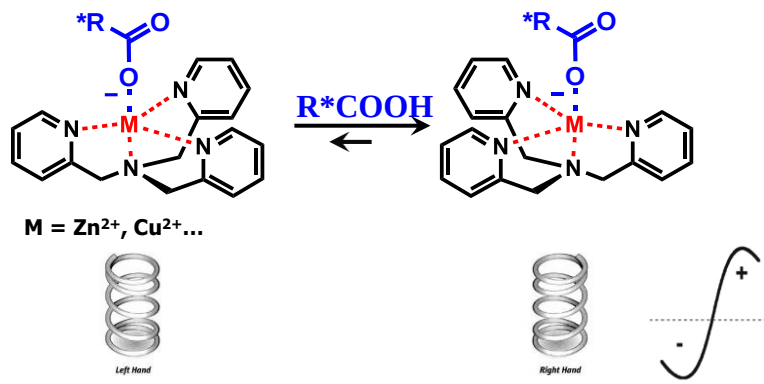
Tris-Pyridylmethyl Amines and Chirality



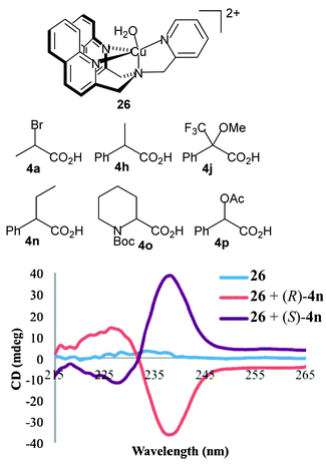
Tris-Pyridylmethyl Amines and Chirality

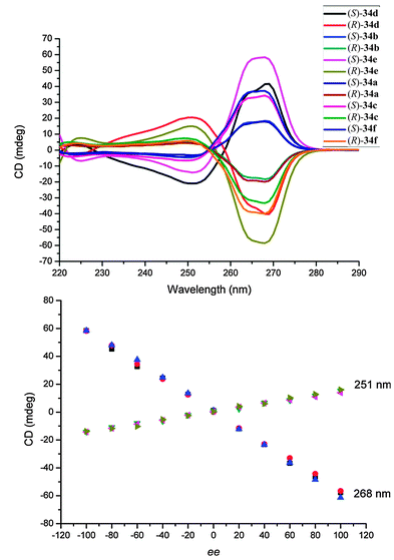


You, L.; Pescitelli, G.; Anslyn, E. V.; Di Bari, L. *J. Am. Chem. Soc.* **2012**, *134*, 7117

StereoDynamic

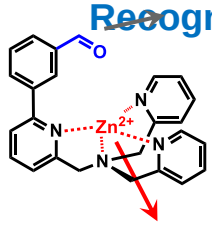
Anslyn Canary system





Molecular Recognition

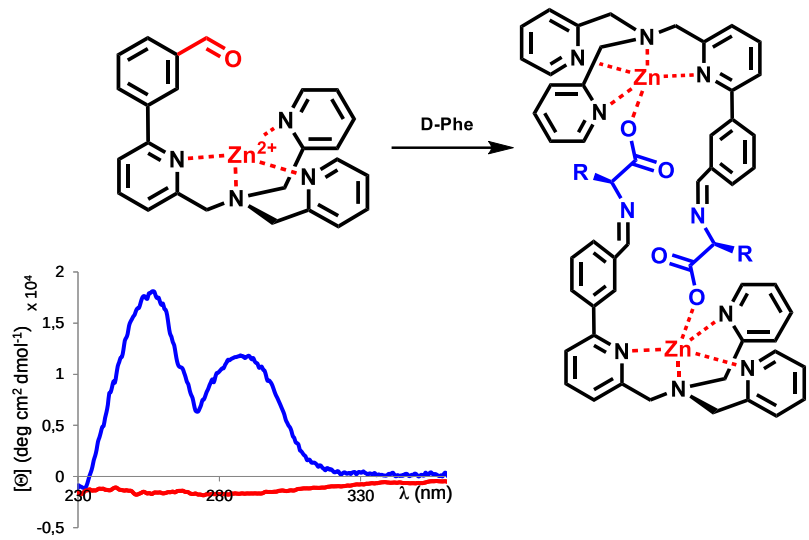
Amine Recognition Site



Carboxylic Acid Recognition Site

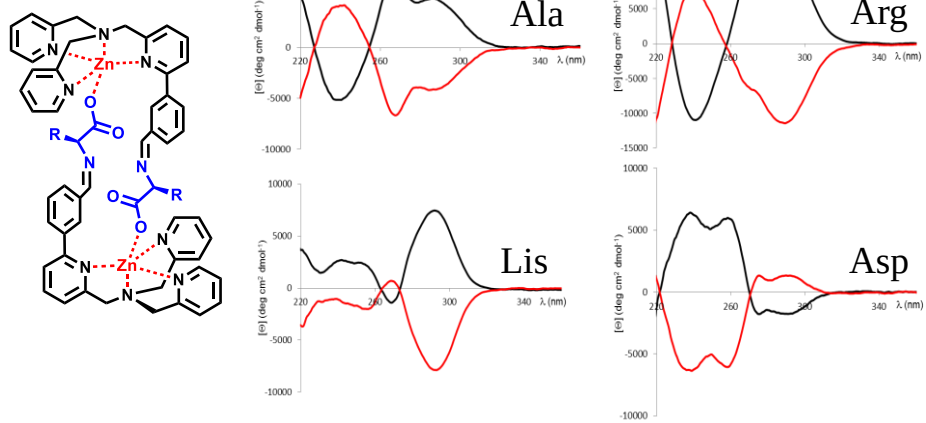
Amino Acids

Optical Probe for Amino Acid EE



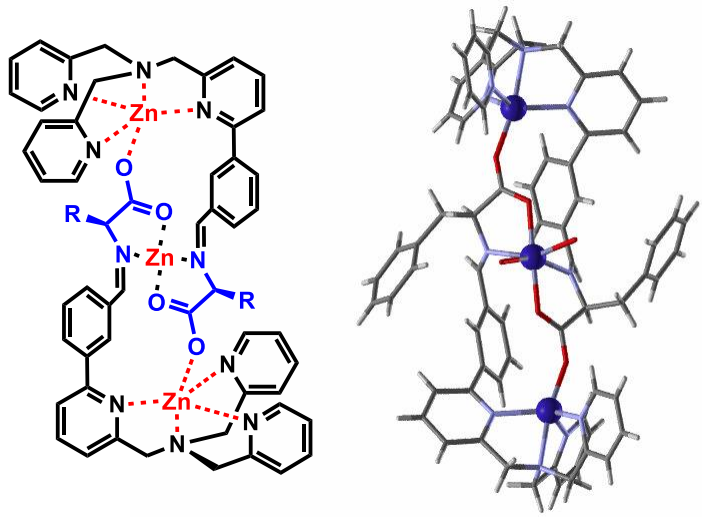
F. A. Scaramuzzo, G. Licini, C. Zonta, *Chem. Eur. J.* **2013**, 19, 16809-16813.

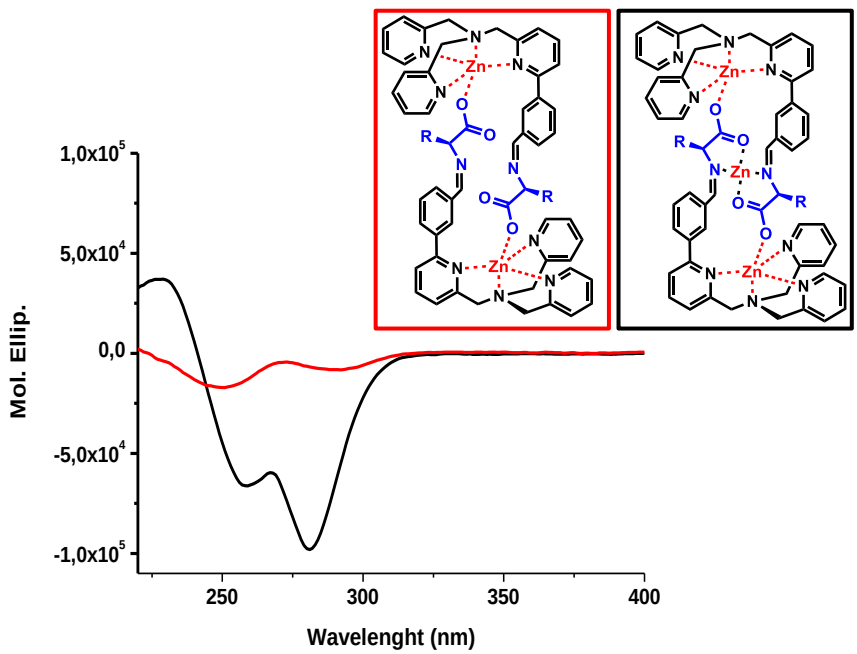
Optical Probe for Amino Acid EE



Chem. Eur. J. **2013**, 19, 16809

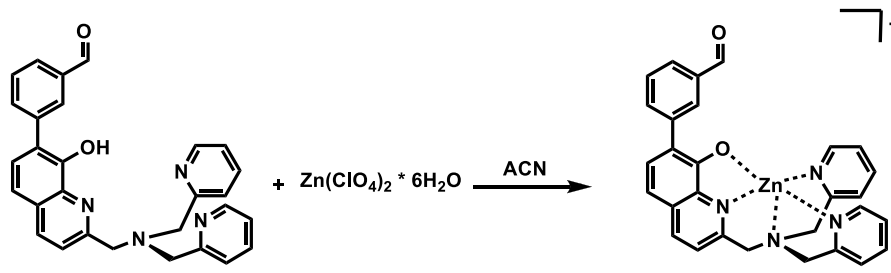
Optical Probe for Amino Acid EE



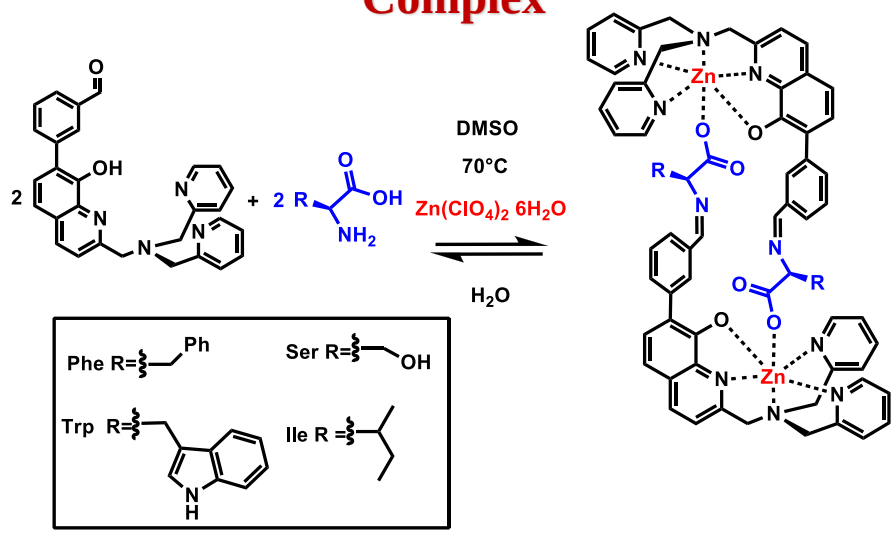


E. Badetti, K. Wurst, G. Licini, C. Zonta *Chem. Eur. J.* **2016**, *19*, 6515.

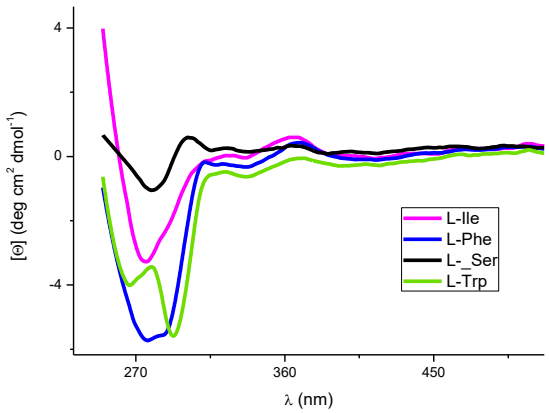
Fluorescence of Zn (II) Complex

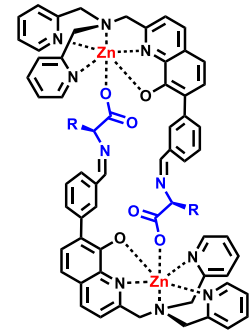


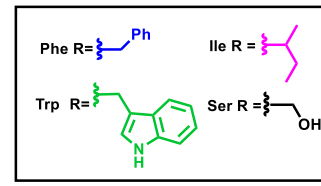
Dimeric Dinuclear Fluorescent Zn (II) Complex



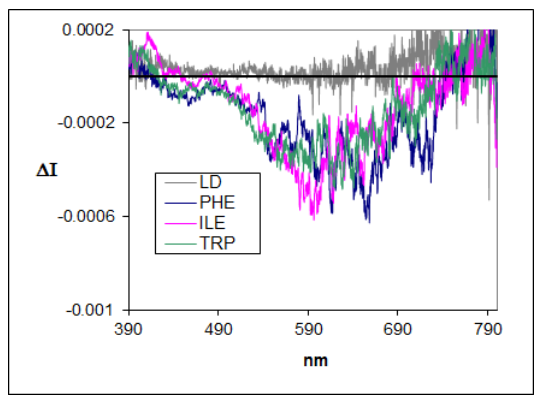
Circular Dichroism

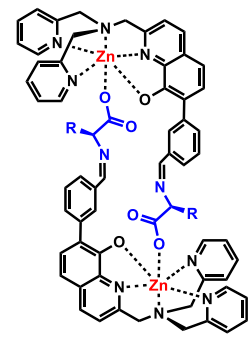


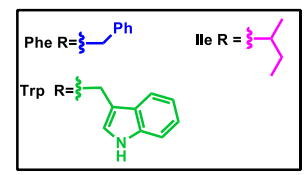




CPL

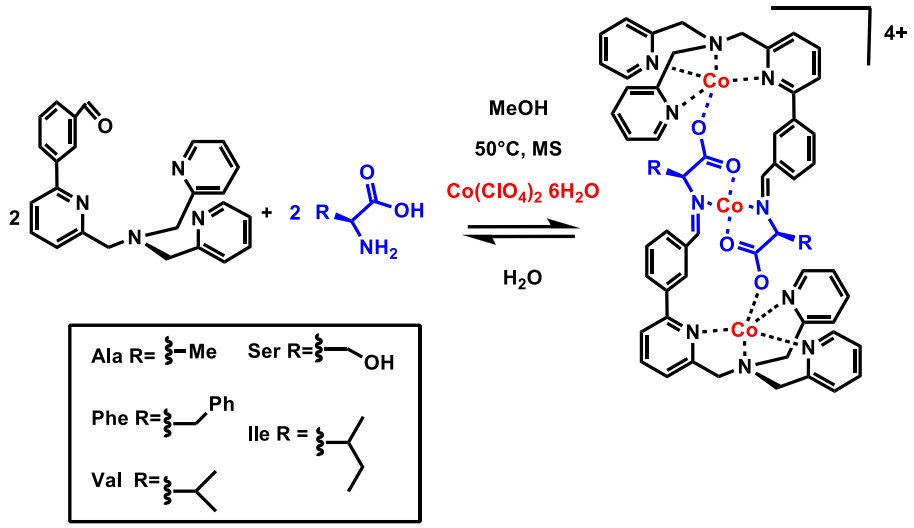




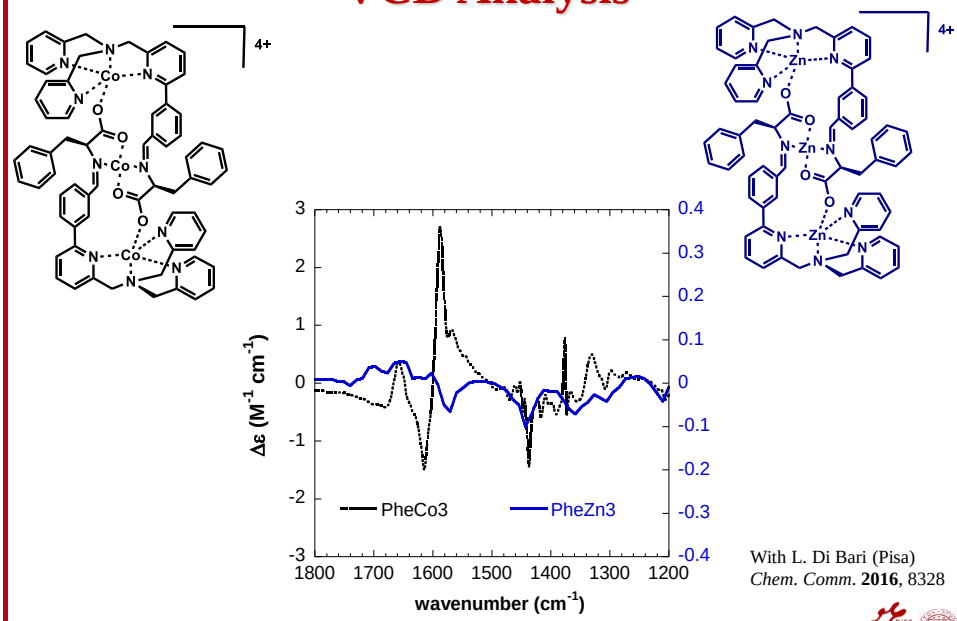


With S. Abbate and G. Longhi
Chirality **2018**, 65

Dimeric Trinuclear Cobalt(II) Complexes

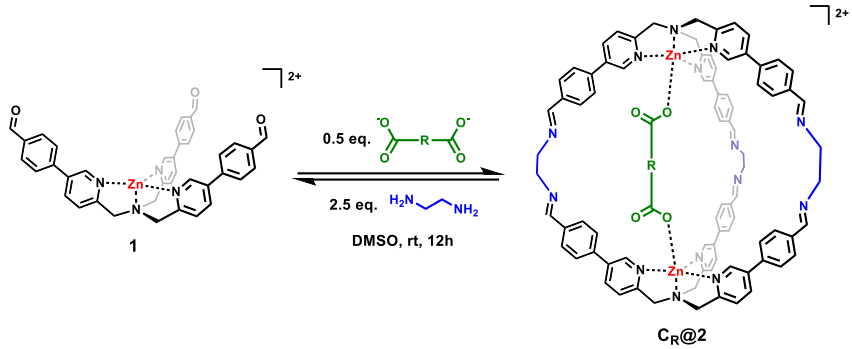


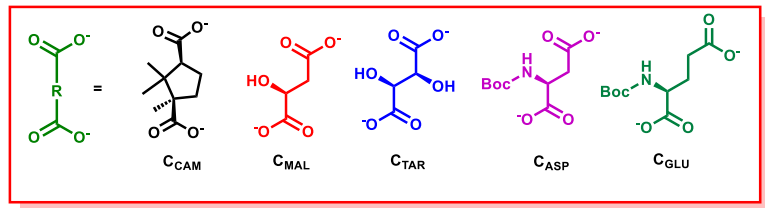
VCD Analysis



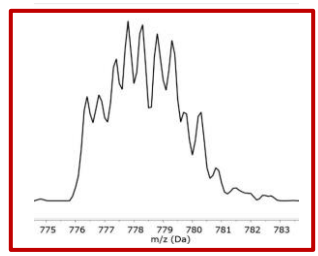
With L. Di Bari (Pisa)
Chem. Comm. **2016**, 8328

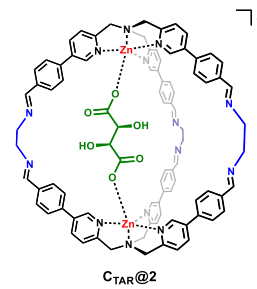
Synthesis of TPMA Molecular cages

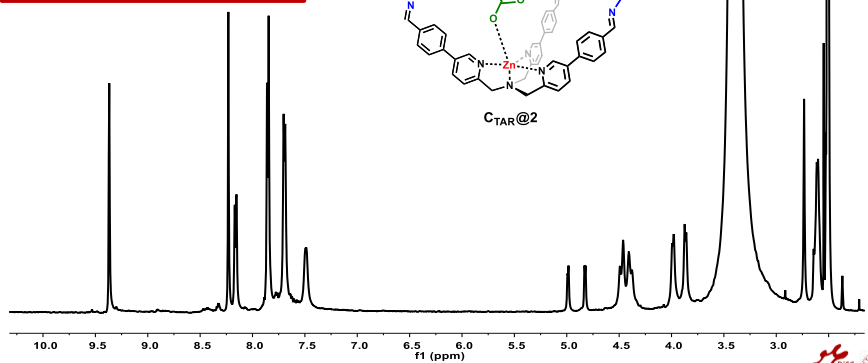




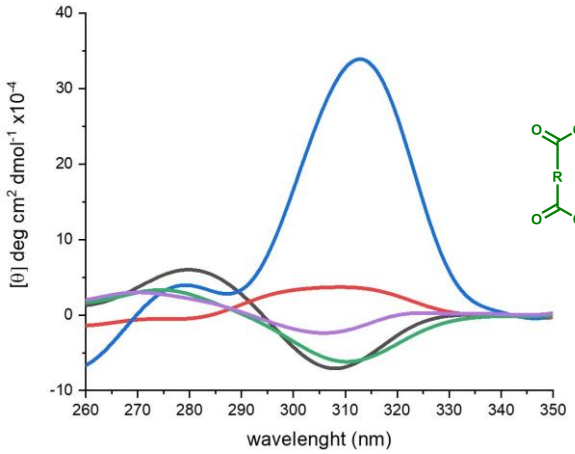
^{1}H-NMR and ESI-MS characterization

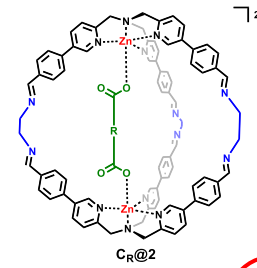


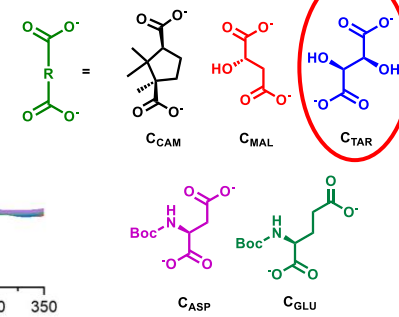




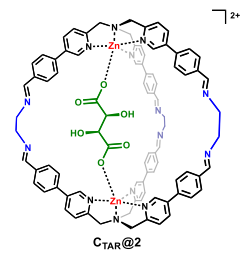
Circular Dichroism investigation

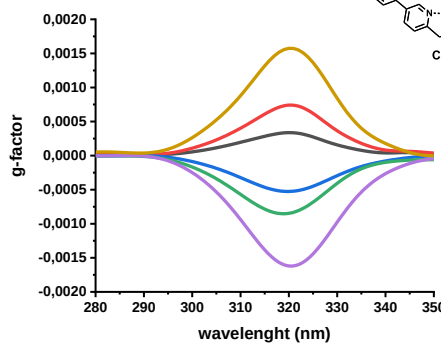


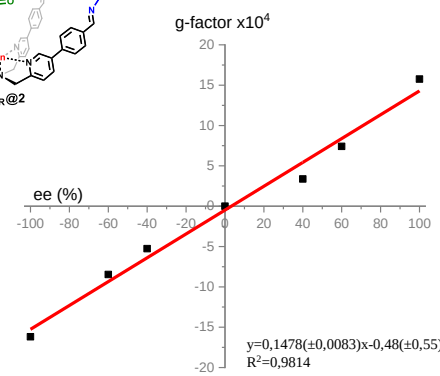




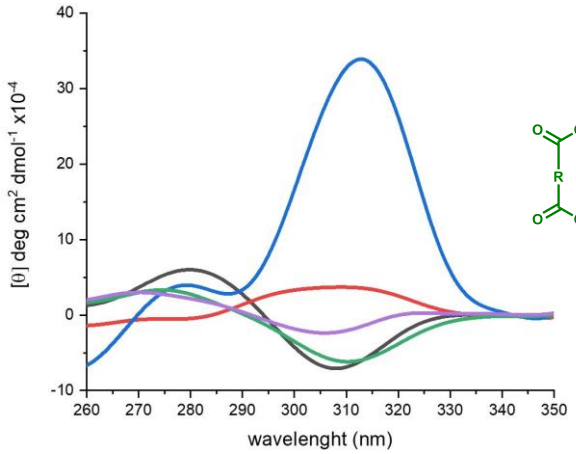
Enantiomeric Excess CD response

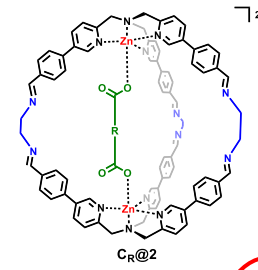


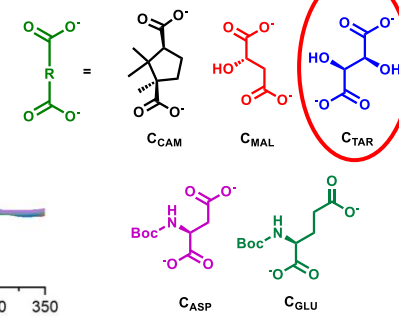




Clarification of the CD Recorded







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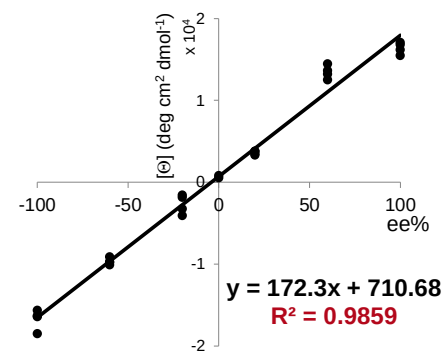
Determination of ee

$$\Theta = \varepsilon \cdot b \cdot c \cdot ee$$



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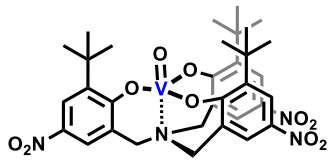
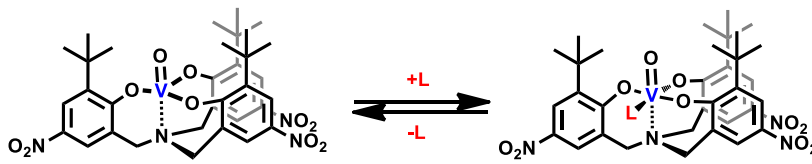
Vanadium AminoTriphenolate System



V is a strong Lewis Acid

NO_2 groups enhance chromophore and Lewis Acid characteristics

Vanadium AminoTriphenolate System



V is a strong Lewis Acid

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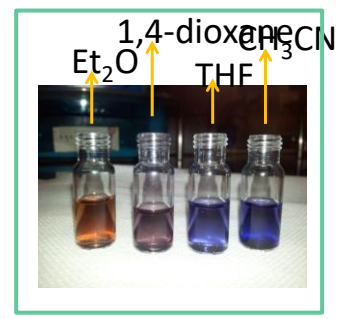
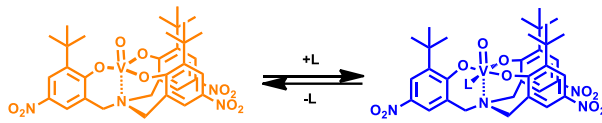
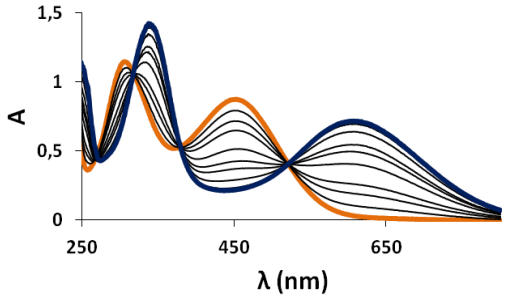
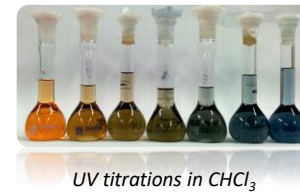


UV - Titrations





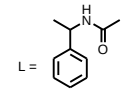


UV titrations in $CHCl_3$
[complex] = 5.0 × 10^{-5}

- 3/4 **isosbestic points** (only 2 vanadium species are involved)
- **Marked red-shifts** in the visible field
- **High binding constants** even for weak Lewis bases

K = 829 ± 60

K = (7,45 ± 0,51) × 10^4



K = (5,06 ± 0,23) × 10^3

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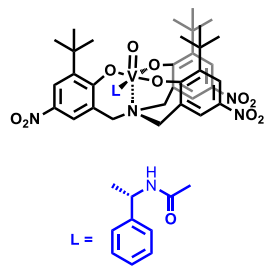
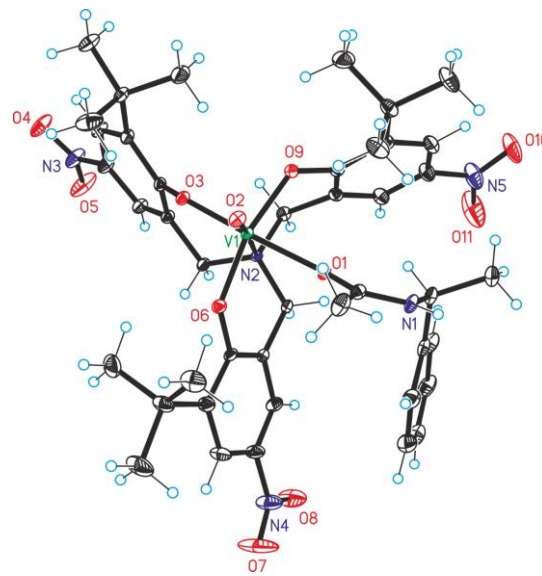
X Ray Crystal Structure



N [(S) 1 phenyletyl]acetamide



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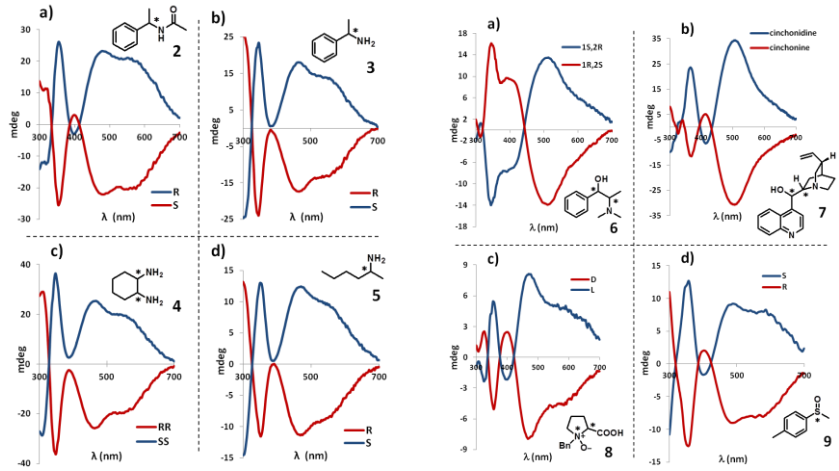
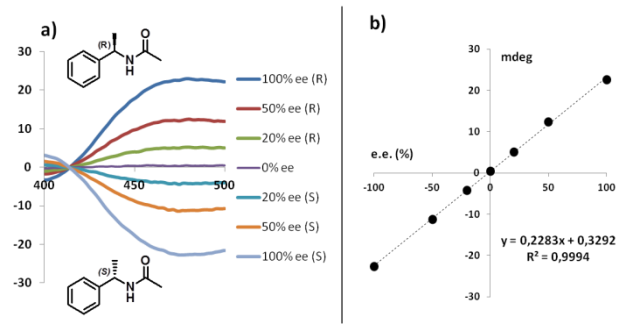
A General Probe for Lewis Bases

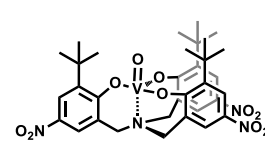


A General Probe for Lewis Bases

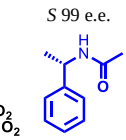


$$\Theta = \varepsilon \cdot b \cdot c \cdot ee$$

e.e. measurement

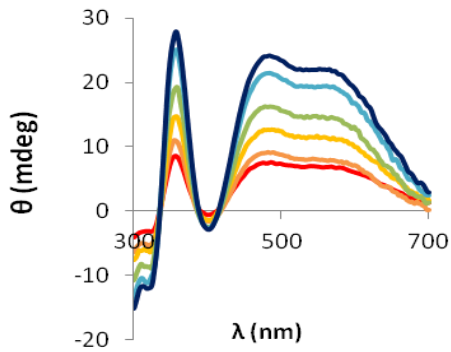


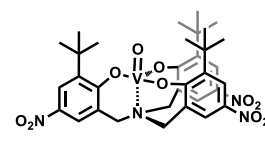
S 99 e.e.



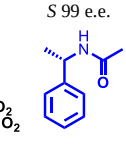
[**1**] (mM)	[**2**] (mM)
0.1	0.03
0.1	0.06
0.1	0.1
0.05	0.1
0.1	0.2
0.1	0.8

e.e. measurement





S 99 e.e.



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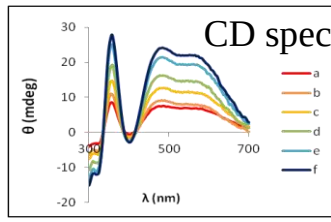
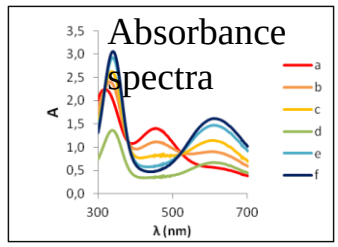
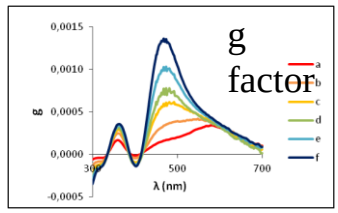
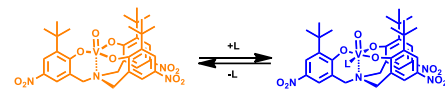


$\Theta = \varepsilon \cdot b \cdot c \cdot ee$

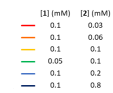


$A = a \cdot b \cdot c$

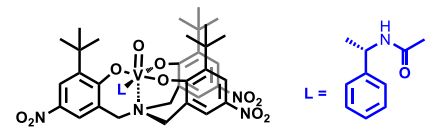


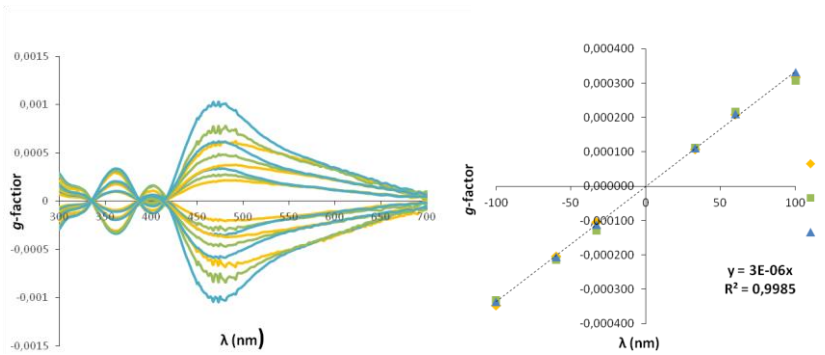


$g = \Theta / A = \varepsilon/a \cdot e.e = g_0 \cdot e.e$



g-probe





«**Concentration-Independent Stereodynamic g-Probe** for Chiroptical ee Determination» *J. Am. Chem. Soc.* **2017**, 15616