

Asymmetric Epoxide Rearrangement Catalyzed by Chiral Brønsted Acids

Group Seminar

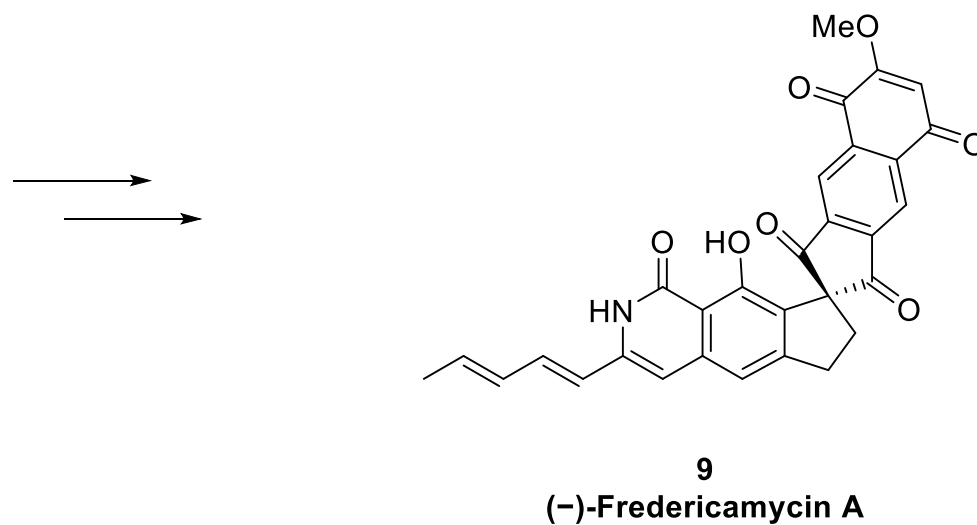
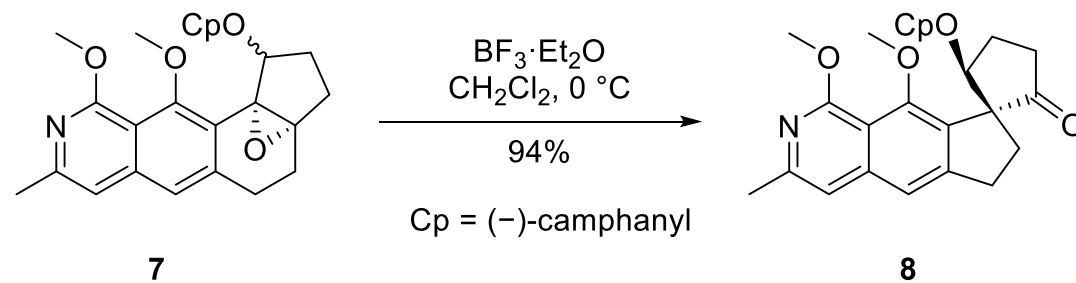
Ihssane El Fdali

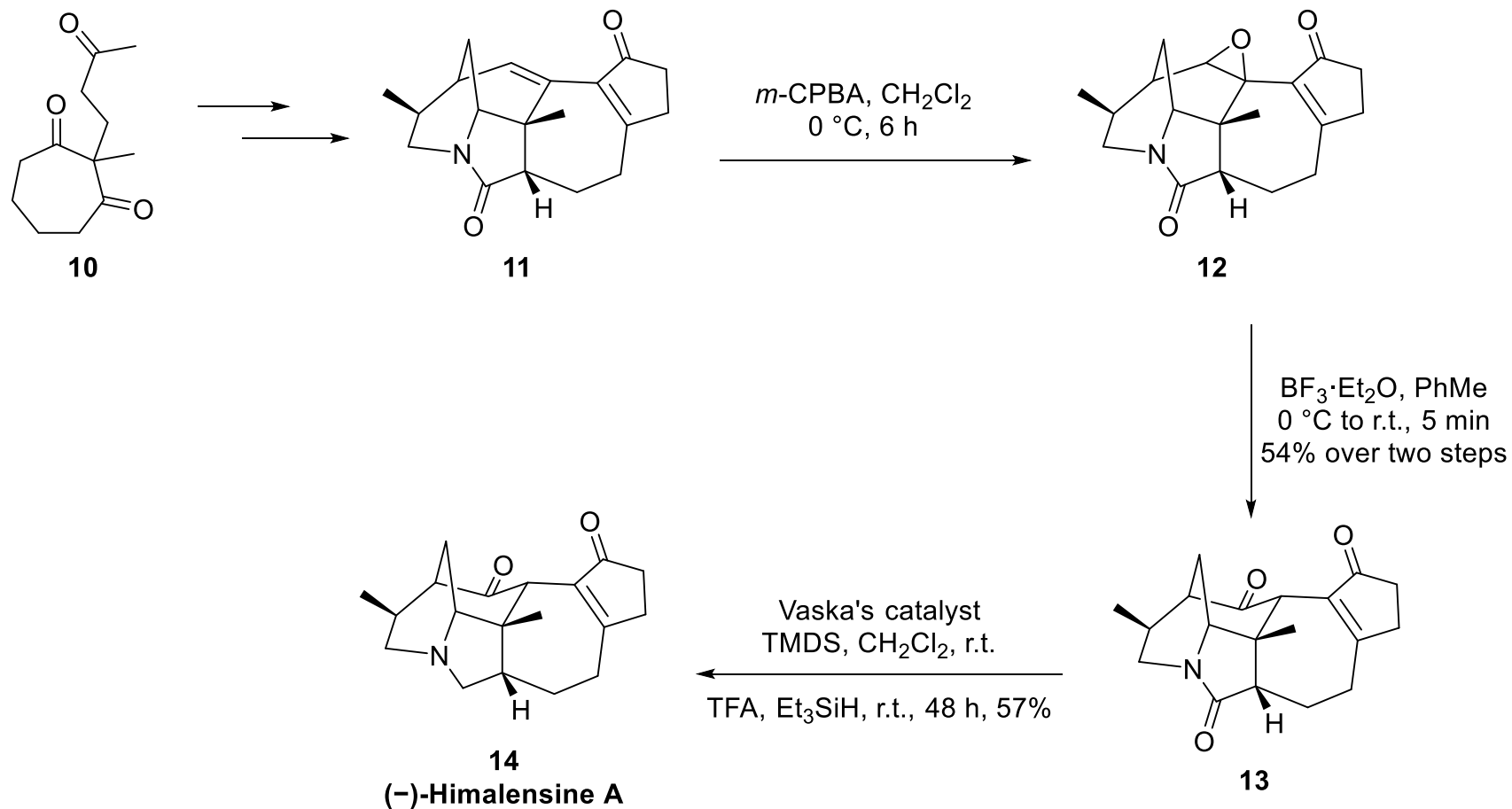
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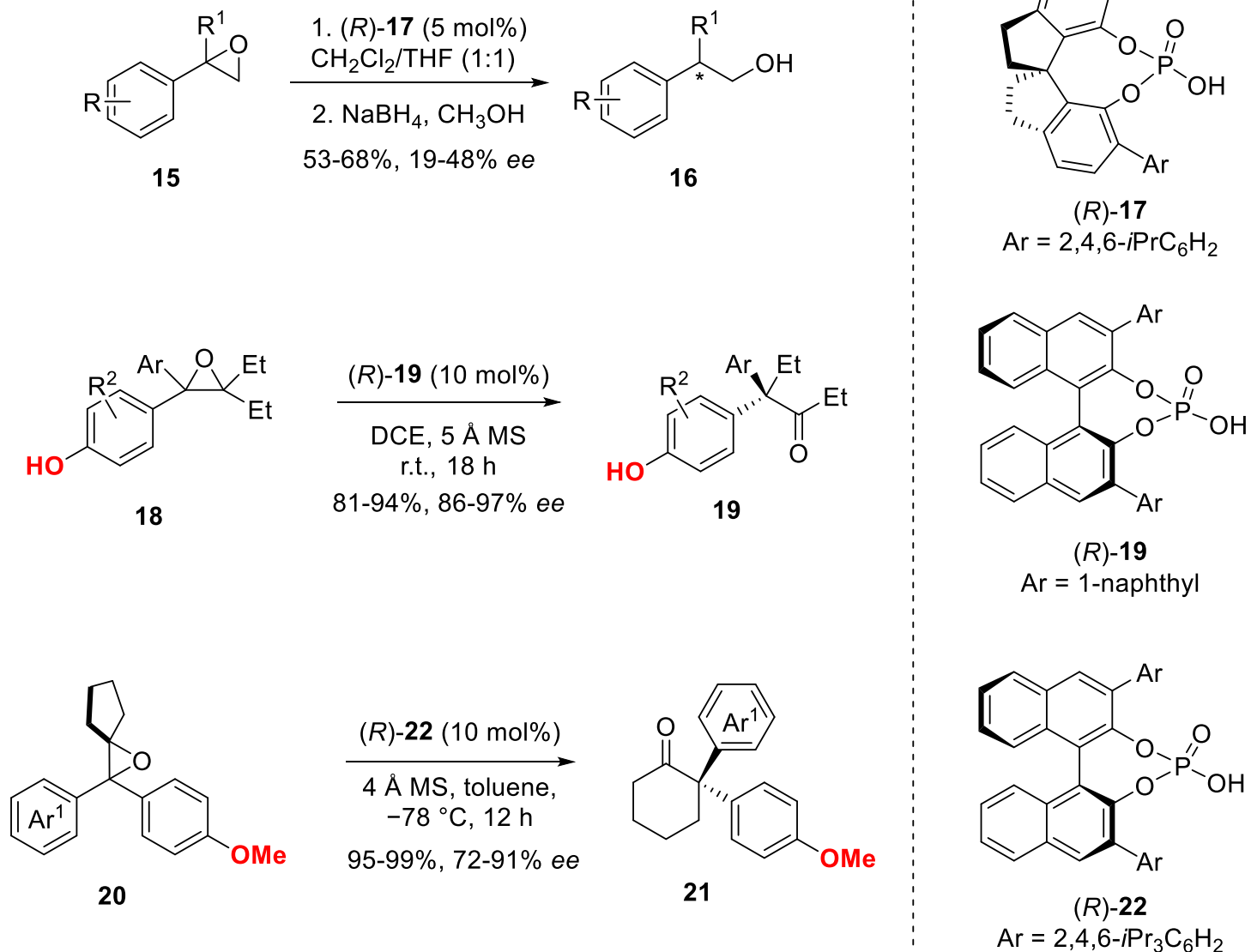
Institute of Organic Chemistry, Justus Liebig University Giessen

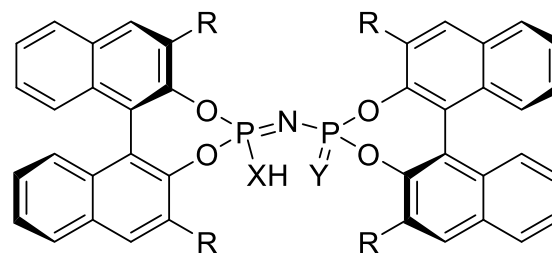




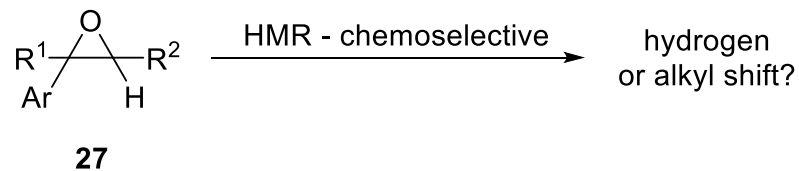
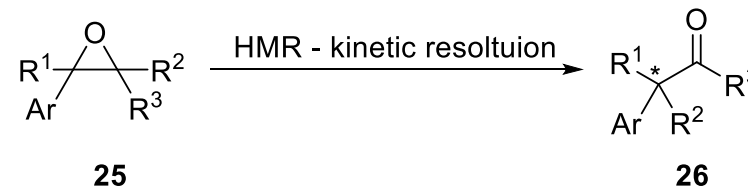
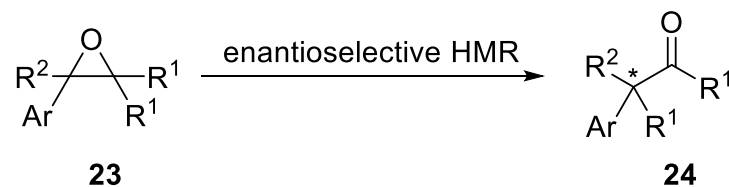


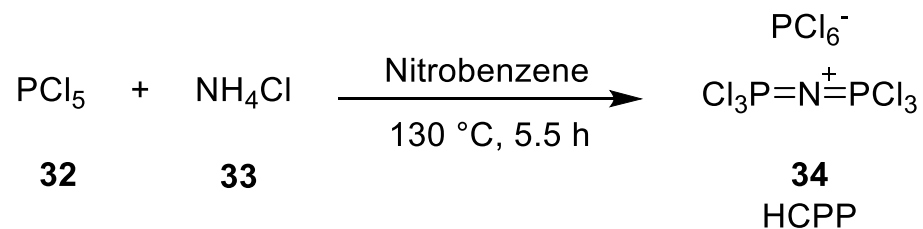
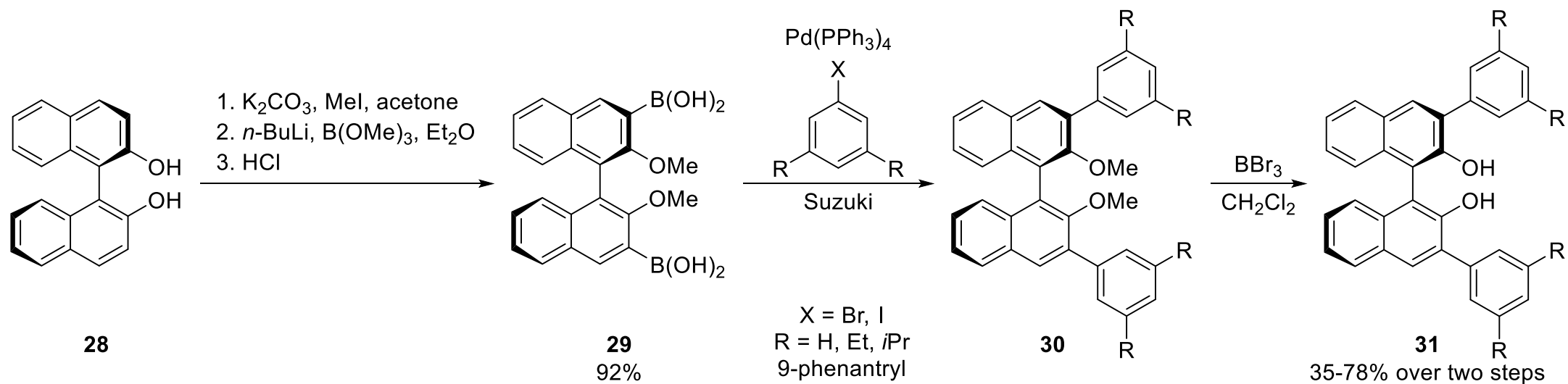






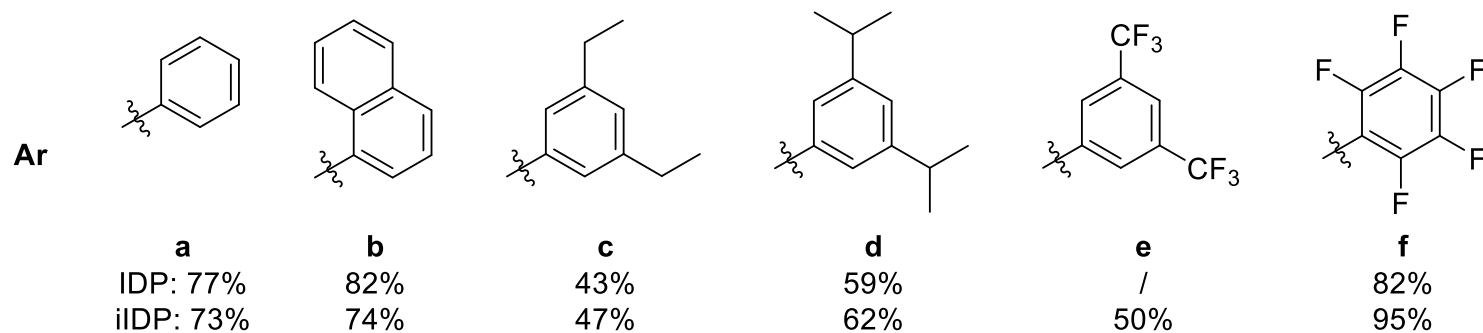
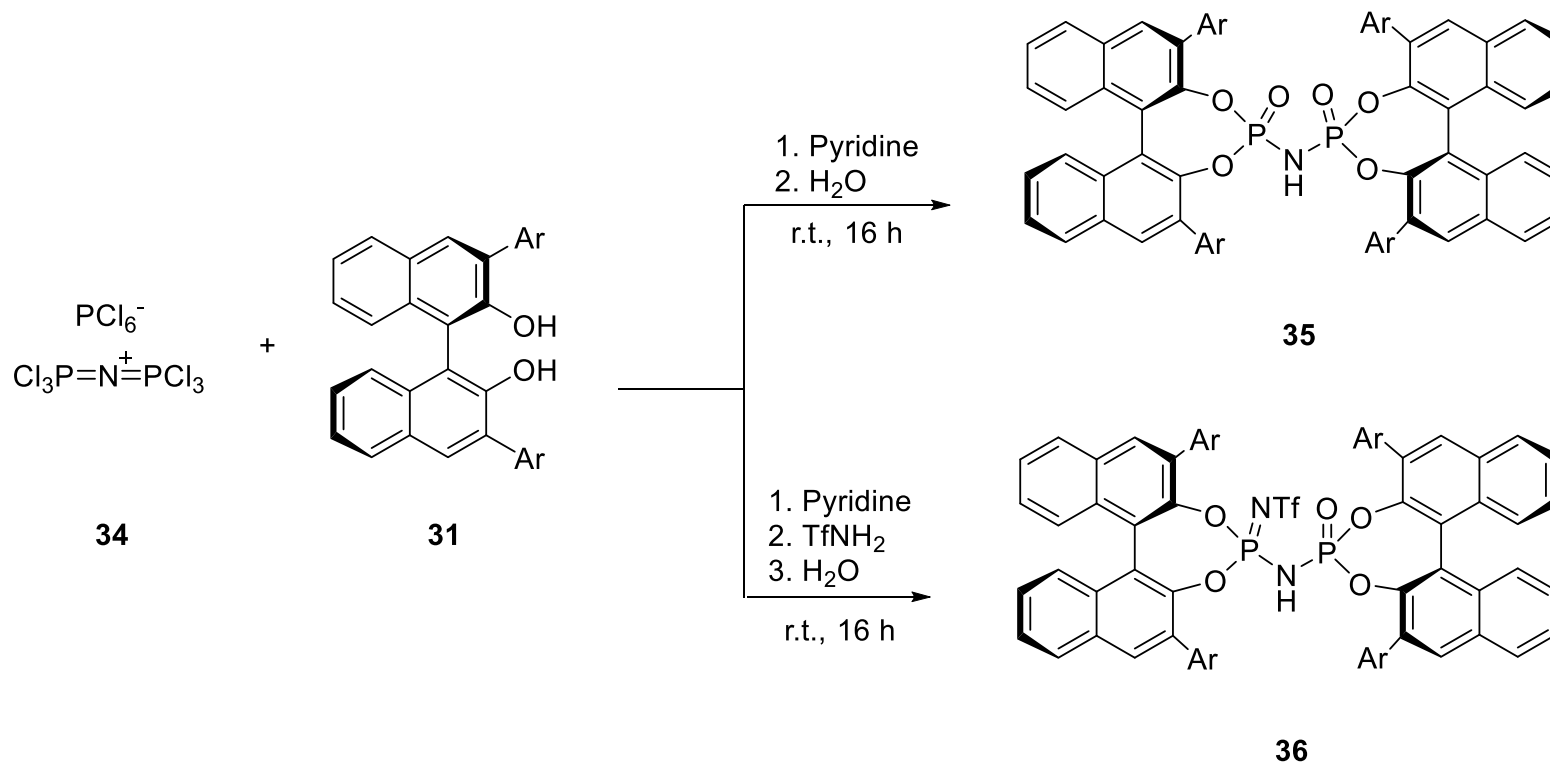
$X = Y = O$: IDP
 $X = \text{NTf}, Y = O$: iIDP
 $X = Y = \text{NTf}$: IDPi

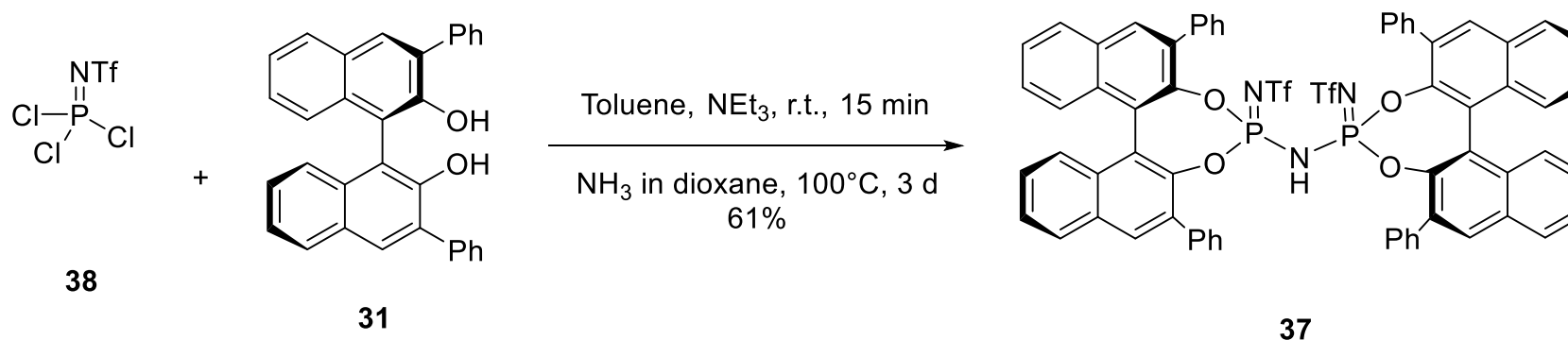
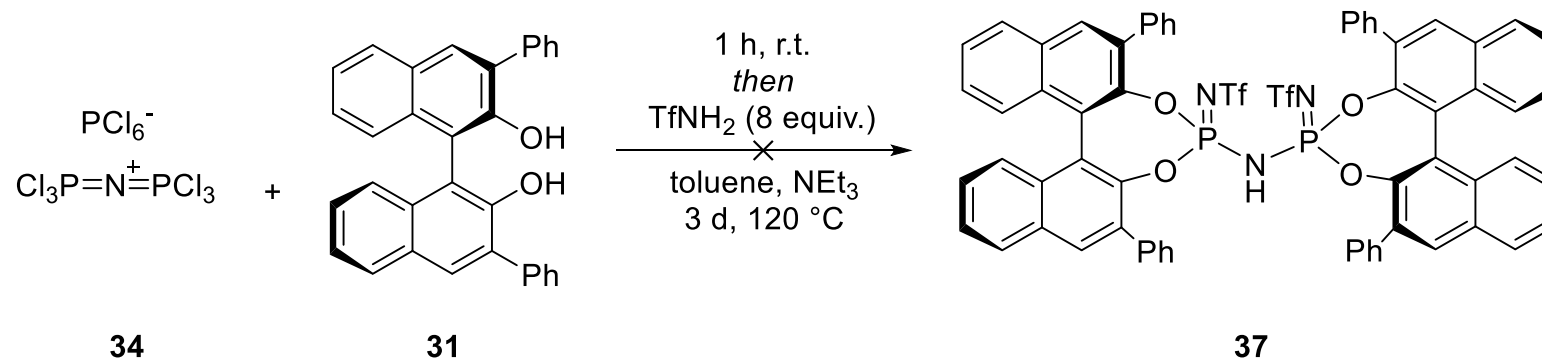


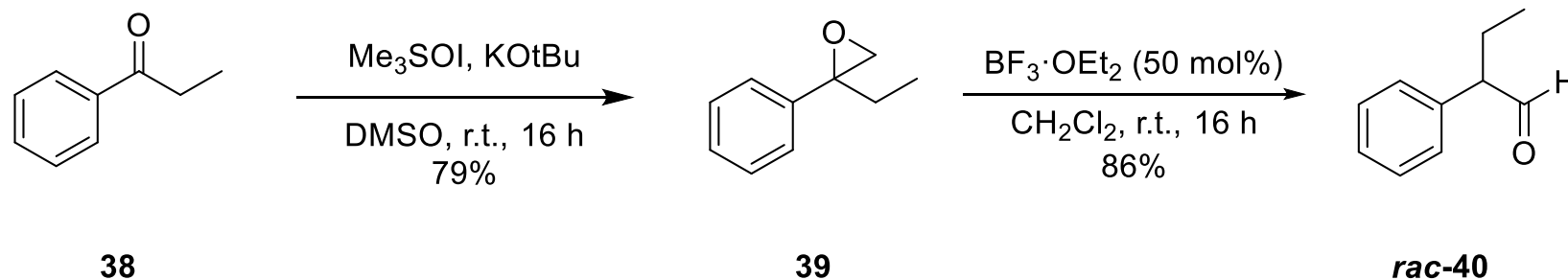


Moisture sensitive
 Stored in the glovebox

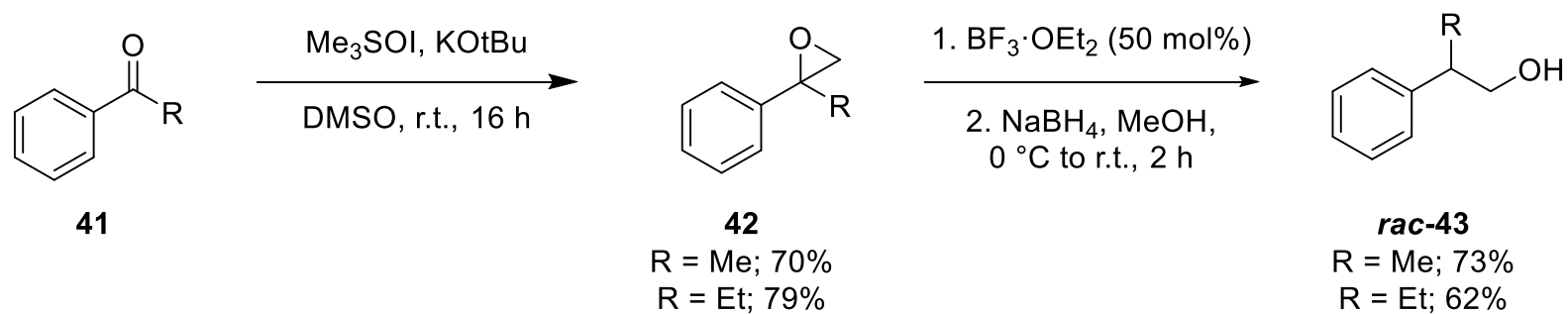
Synthesis of the Catalysts

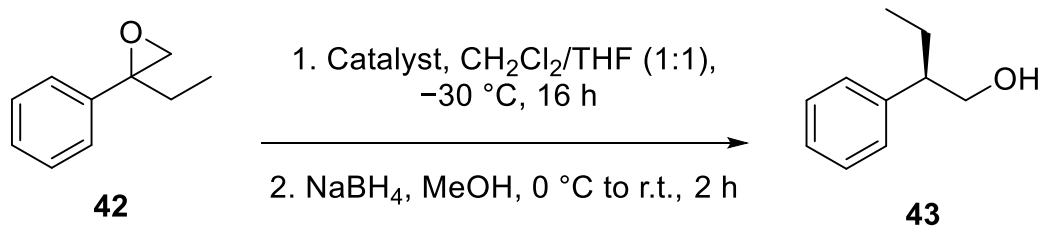






- Labile during purification
- Racemizes at r.t. over time





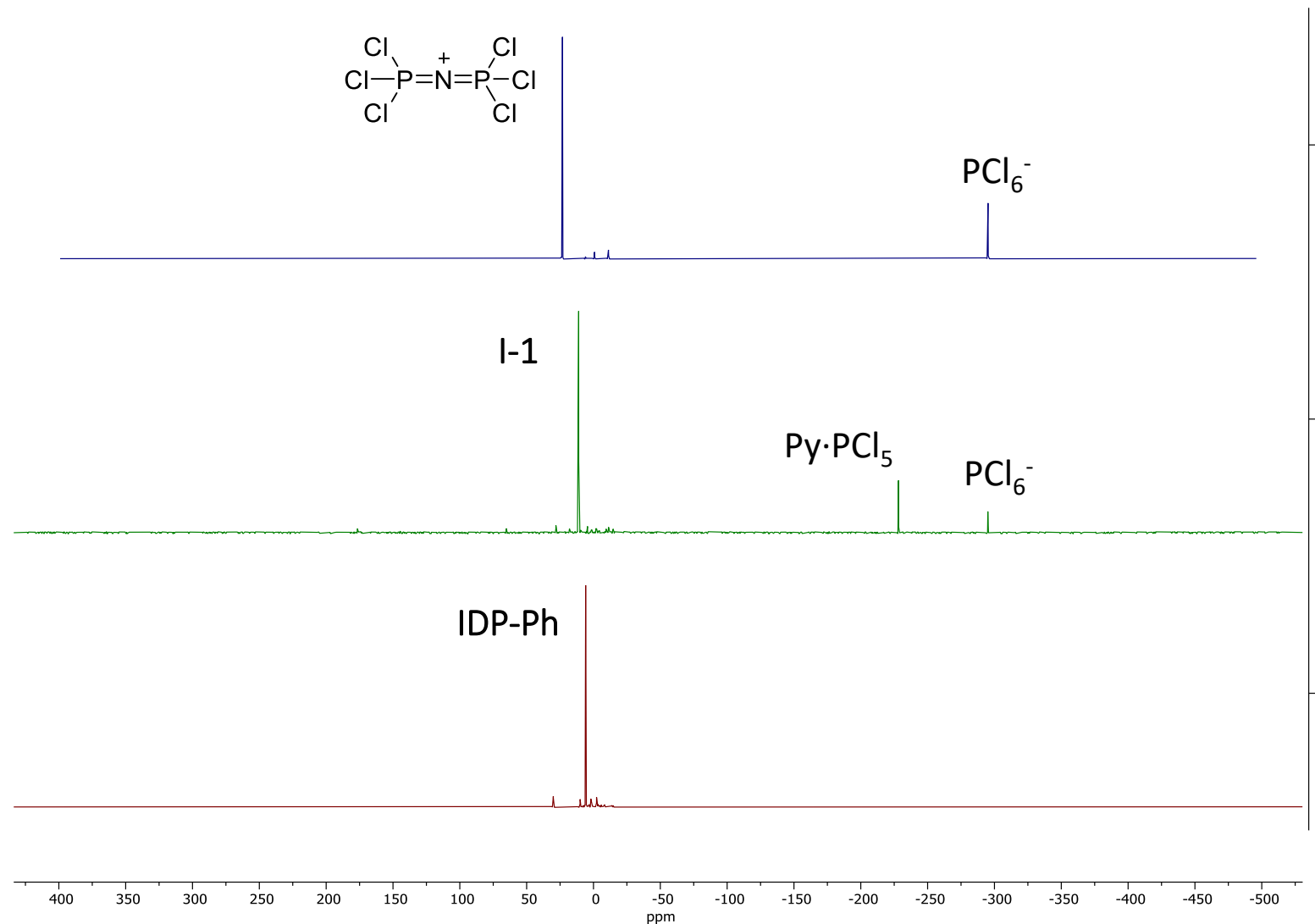
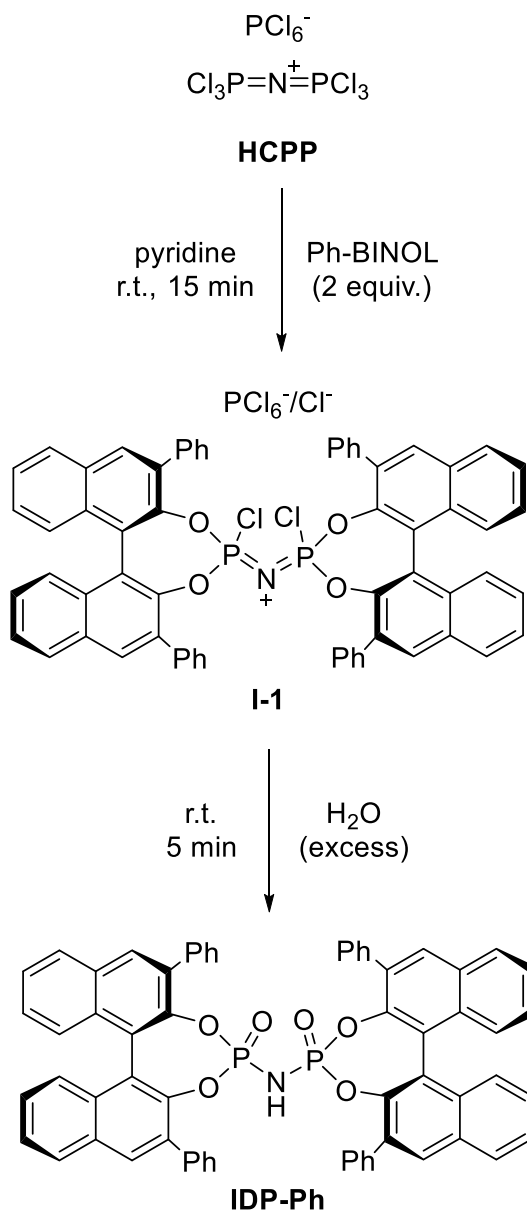
Entry	Catalyst (mol%)	ee (%)	Conversion (%)	Yield (%)
1	35a (5)	0	18	4
2	36a (5)	8	quant.	91
3	37a (5)	4	quant.	86
4	37a (1)	4	quant.	75
5	44b (10)	4	75	33
6	44b (5)	4	30	18
7	35b (5)	28	55	13
8 ^[a]	35b (5)	28	65	10
9	36b (5)	15	quant.	quant.
10	44g (5)	13	quant.	quant.
11	36e (5)	14	quant.	quant.

Catalyst
35: IDP
36: *i*IDP
37: IDPi
44: *N*-triflyl phosphoramidate

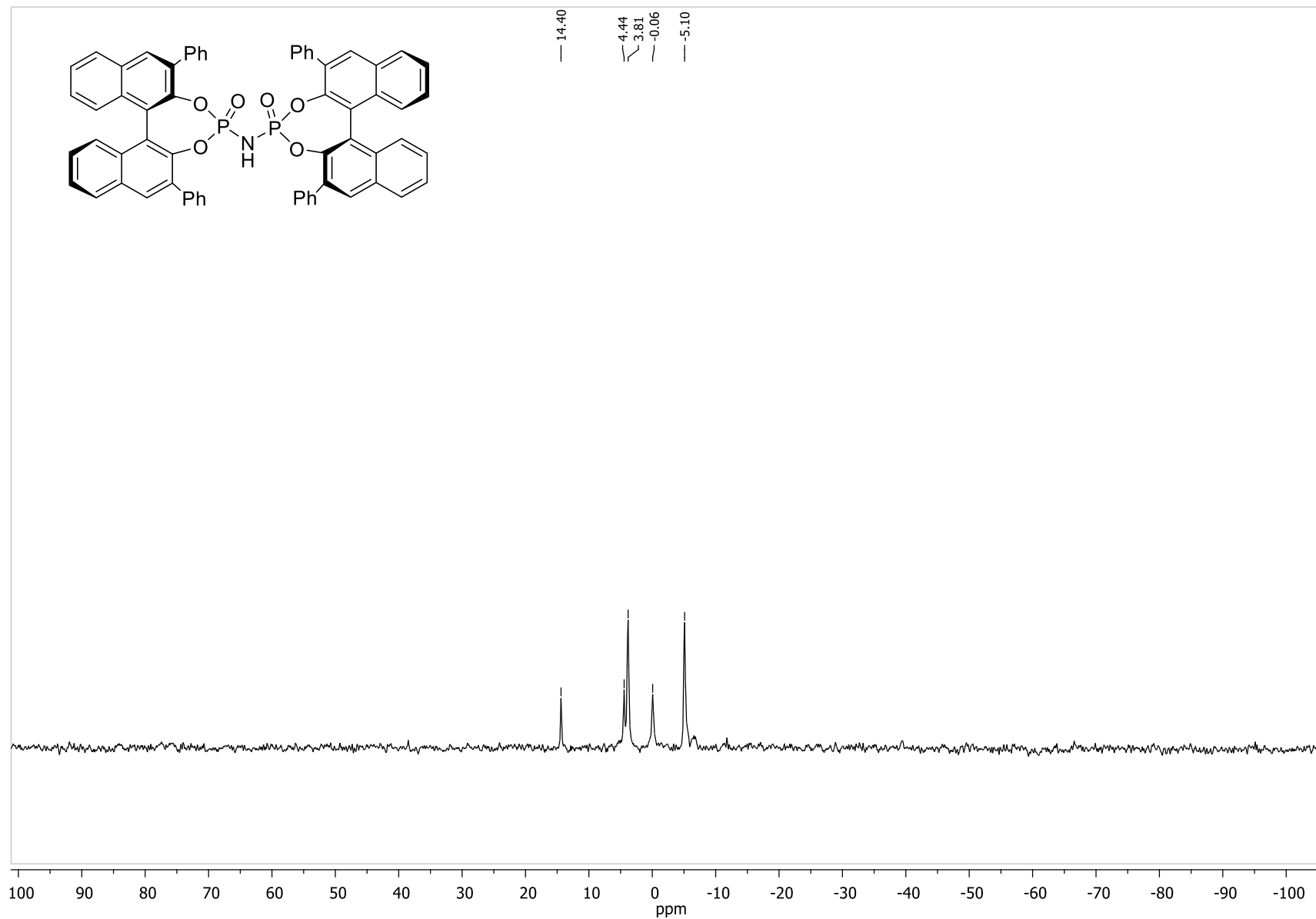
a: phenyl
b: 1-naphthyl
e: 3,5-trifluoromethylphenyl
g: 9-phenanthryl

All reactions were carried out on a 0.2 mmol scale and 0.5 M concentrations. Yield and conversions were determined by ¹H-NMR using *p*-chlorobenzaldehyde as internal standard. ^[a]4 Å MS were added to the reaction mixture.

Purity of the Catalysts: NMR experiment

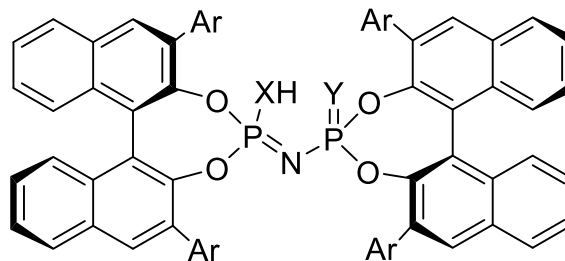


Purity of the Catalysts: workup, purification, and acidification

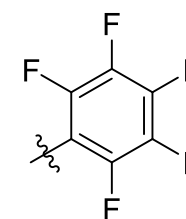
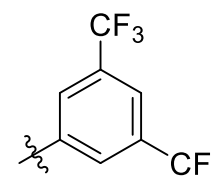
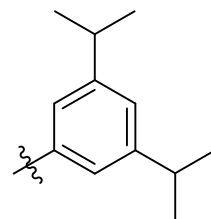
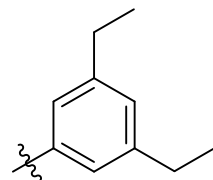
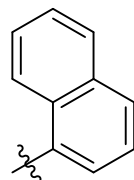
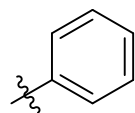


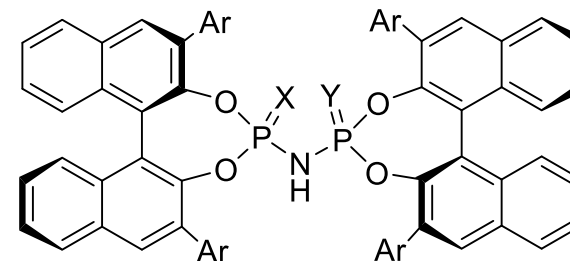
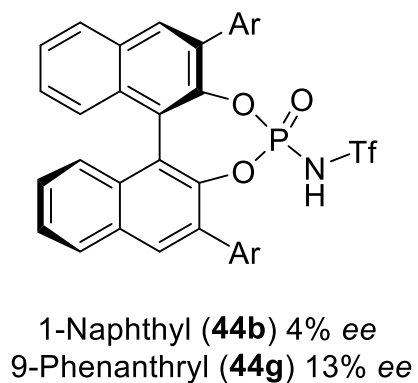
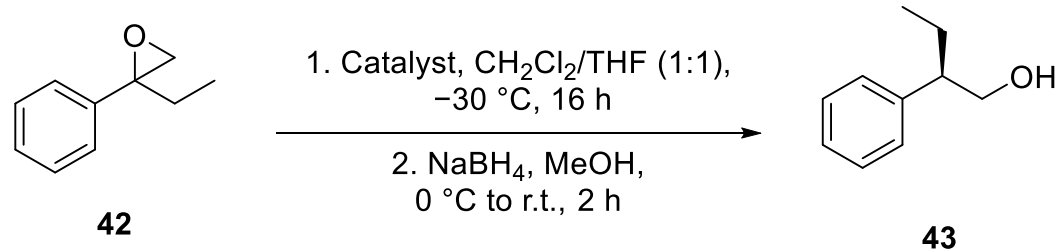


- Synthesis of multiple BINOL derivatives
- Synthesis of the substrates
- Synthesis of the standards through BF_3 -catalyzed rearrangement
- Synthesis of catalysts



Ar





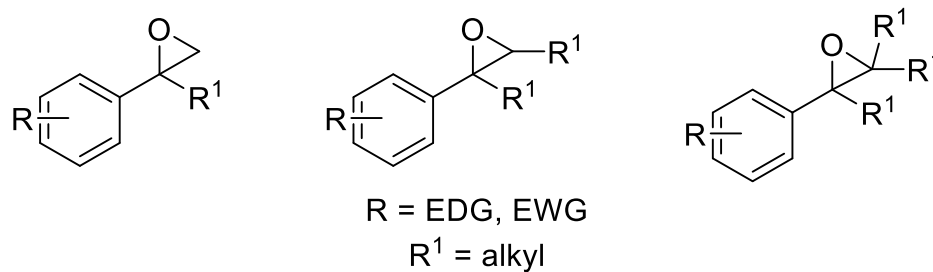
IDP: X = Y = O
 Phenyl (**35a**) 4% ee
 1-Naphthyl (**35b**) 28% ee

iIDP: X = O, Y = NTf
 Phenyl (**36a**) 8% ee
 1-Naphthyl (**36b**) 15% ee
 3,5-(CF₃)₂C₆H₃ (**36e**) 14% ee

IDPi: X = Y = NTf
 Phenyl (**37a**) 4% ee

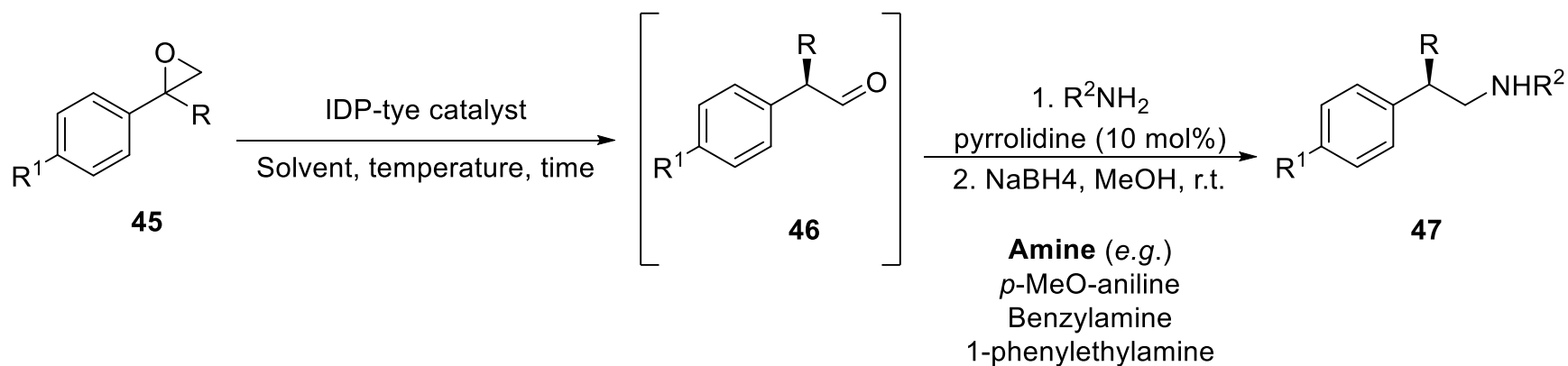


- Purification of the catalysts
- Application of other IDP and iIDP catalysts in the rearrangement
 - *e.g.*, -C₆F₅, 9-phenanthryl, 1-pyrenyl
- Investigation of the influence of dispersion energy donors (DED)
- How do the yield and *ee* depend on the acidity of the catalyst?
- Synthesis of different substrates





- Optimization of reaction conditions (DoE)
- Computational investigation
- Different functionalization of the aldehyde



Acknowledgements



- Prof. Peter R. Schreiner
- Friedhelm
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- PRS Group

