

Massachusetts Institute of Technology
Organic Chemistry 5.512

May 11, 2007
Prof. Rick L. Danheiser

Unit 10
Stereocontrolled Epoxidation

- ★ Substrate Control: 1,2-Asymmetric Induction
- ★ Reagent Control: Sharpless-Katsuki Asymmetric Epoxidation (AE)
- ★ Synthetic Elaboration of AE Products
- ★ Reagent Control: Jacobsen-Katsuki AE
- ★ Reagent Control: Shi AE

★ **Jacobsen-Katsuki Asymmetric Epoxidation**

Reviews

"Asymmetric Epoxidation of Unfunctionalized Olefins and Related Reactions" Katsuki, T. In *Catalytic Asymmetric Synthesis*; Ojima, I., Ed.; Wiley-VCH, 2000, pp 287-326.

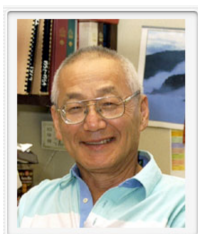
"Asymmetric Catalysis of Epoxide Ring-Opening Reactions" Jacobsen, E. N. *Acc. Chem. Res.* **2000**, 33, 421.

"Chromium- and Manganese-salen Promoted Epoxidation of Alkenes" McGarrigle, E. M.; Gilheany, D. G. *Chem. Rev.* **2005**, 105, 1563.

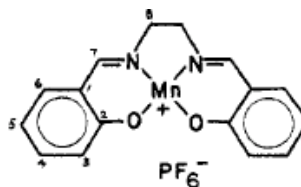
"Advances in Homogeneous and Heterogeneous Catalytic Asymmetric Epoxidation" Xia, Q.-H. et al. *Chem. Rev.* **2005**, 105, 1603.

"Catalytic Asymmetric Epoxide Ring-Opening Chemistry" Nielsen, L. P. C.; Jacobsen, E. N. In *Aziridines and Epoxides in Organic Synthesis*; Yudin, A. K., Ed.; Wiley-VCH, 2006, pp 229-269.

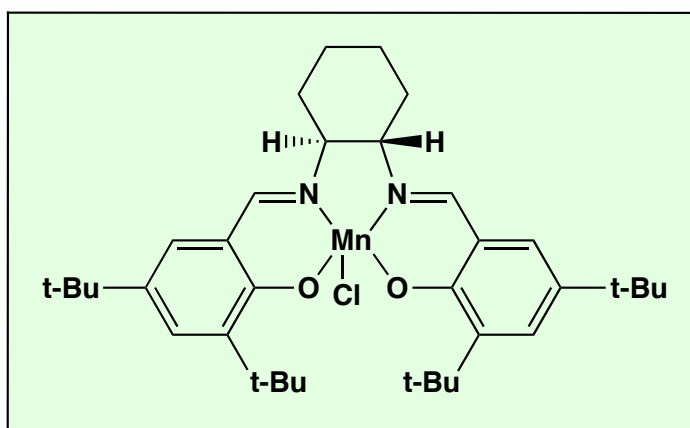
Jay Kochi



Cr and Mn(salen)-catalyzed epoxidations

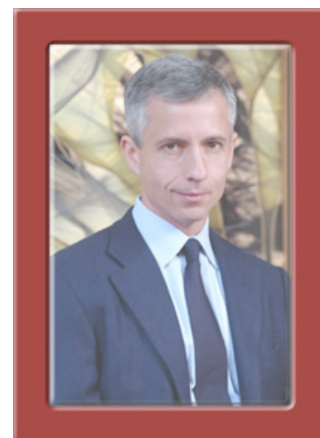


★ Jacobsen-Katsuki Asymmetric Epoxidation



Jacobsen Manganese Salen Catalyst

(*S,S*)-(salen)Mn-Cl

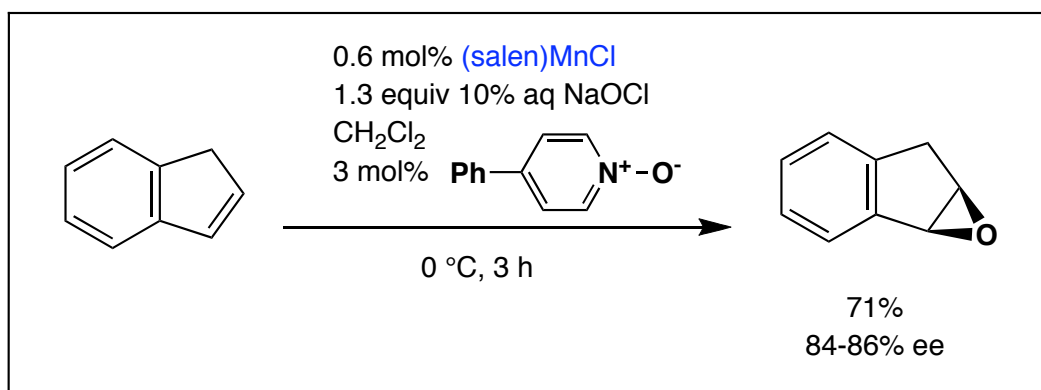


Eric Jacobsen



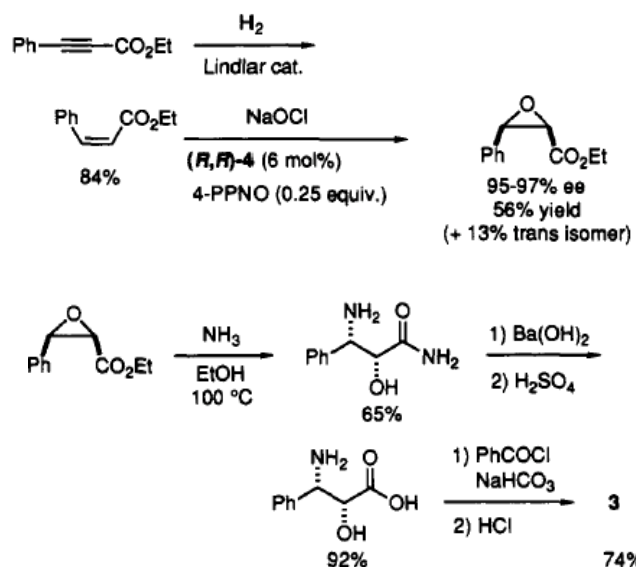
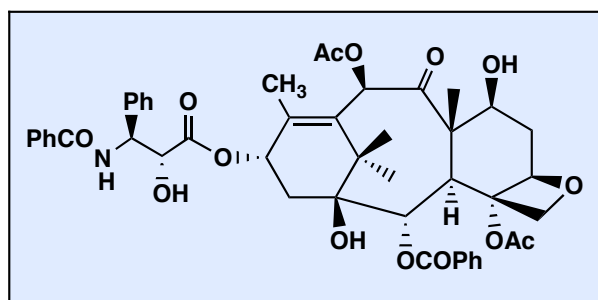
Tsutomu Katsuki
Kyushu University

E. N. Jacobsen et al. *Org. Synth.* **1999**, 76, 46



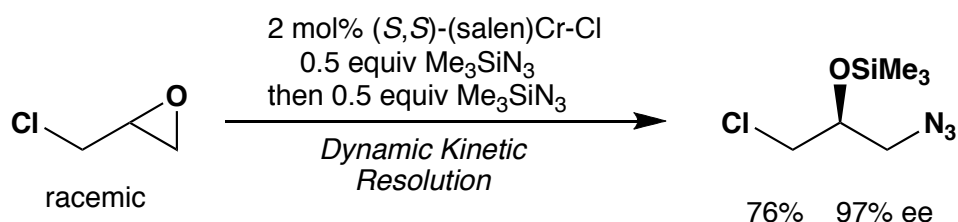
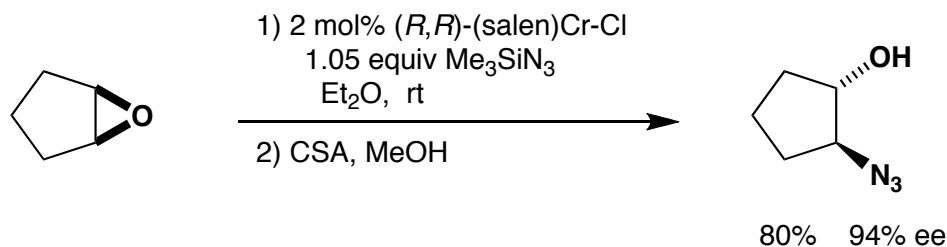
Case Study: Side Chain of Taxol

Deng, L.; Jacobsen, E. N.
J. Org. Chem. **1992**, 57, 4320

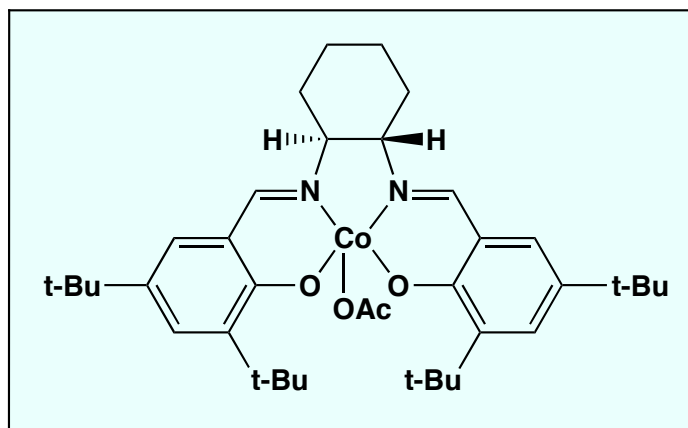


★ Jacobsen-Katsuki Asymmetric Epoxidation

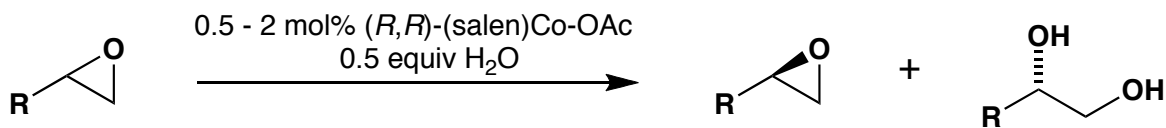
Enantioselective Epoxide Opening



Hydrolytic Kinetic Resolution



(*S,S*)-(salen)Co-OAc



Both products
95-99% ee

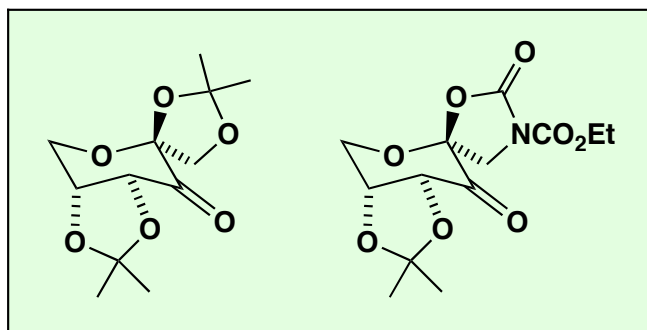
Bu	43%	44%
Cyh	44%	41%
CH ₂ OTBS	47%	42%
CH ₂ CO ₂ Et	44%	41%
CH=CH ₂	36%	38%
C≡CSiR ₃	41%	41%

★ Shi Asymmetric Epoxidation

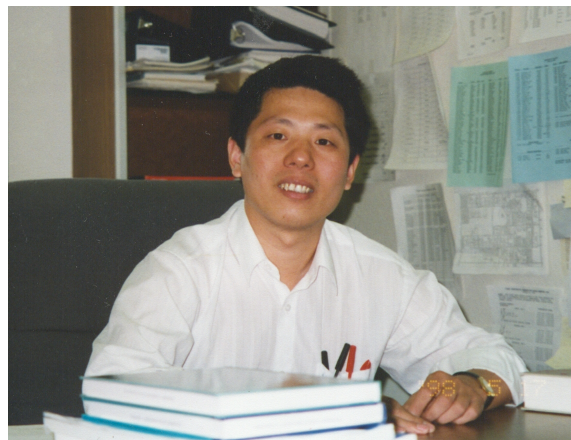
Reviews

"Organocatalytic Asymmetric Epoxidation of Olefins by Chiral Ketones" Shi, Y. *Acc. Chem. Res.* **2004**, 37, 488.

"Organocatalytic Oxidation. Ketone-Catalyzed Asymmetric Epoxidation of Olefins" Shi, Y. In *Modern Oxidation Methods*; Bäckvall, J.-E., Ed.; Wiley-VCH, 2004, pp 51-82.



Ketones for Shi Epoxidation



Yian Shi

Y. Shi et al. *Org. Synth.* **2003**, 80, 9

