

Catalytic stereoselective [2,3]-rearrangement reactions



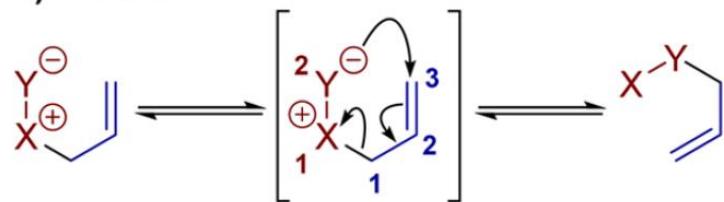
Examples include [2,3]-rearrangement of:

- Onium ylides
- O-Propargylic oximes
- Sulfoxides, selenoxides, sulfimides, and N-oxides
- [2,3]-Wittig rearrangements

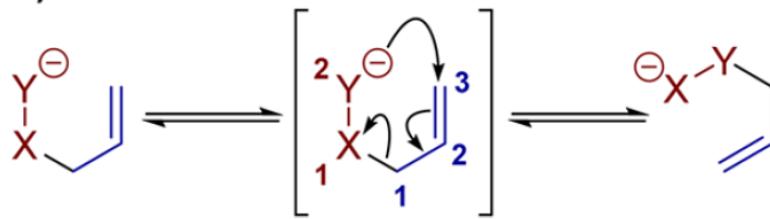
*Reporter: Li Li
Supervisor: Yong Huang
2018-4-16*

General classifications of [2,3]-sigmatropic rearrangements

a) Neutral

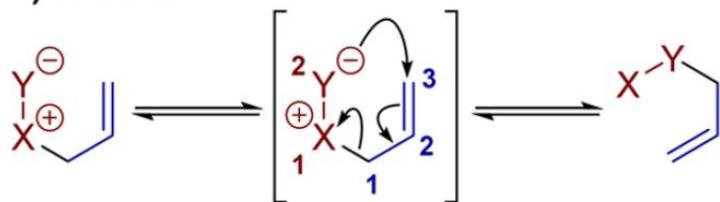


b) Anionic

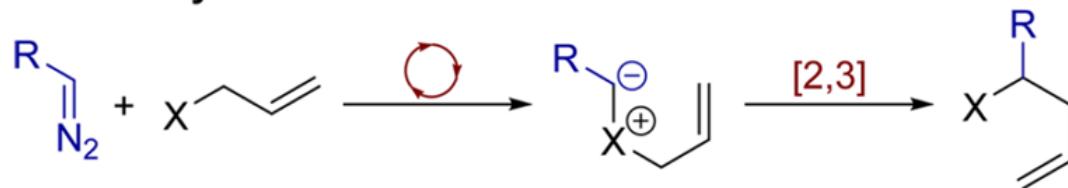


General classifications of [2,3]-sigmatropic rearrangements

a) Neutral

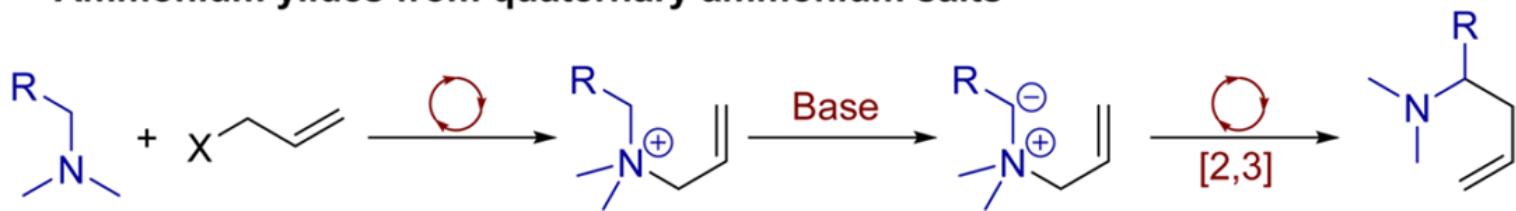


Onium ylides from metal carbenoids



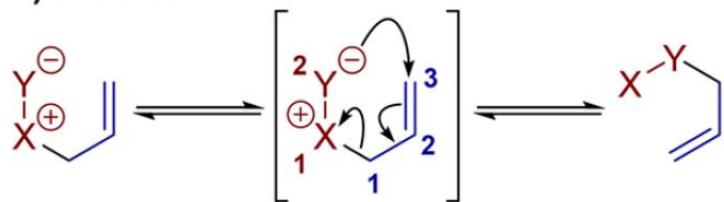
X = R₂N, RO, RS, halogen

Ammonium ylides from quaternary ammonium salts

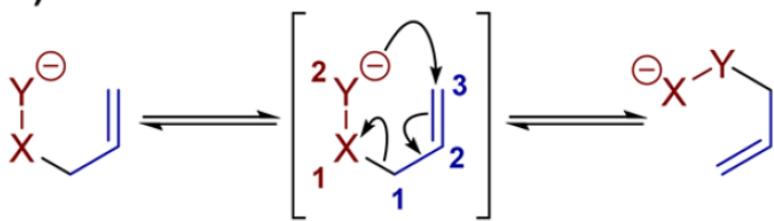


Overview of catalytic [2,3]-rearrangements discussed

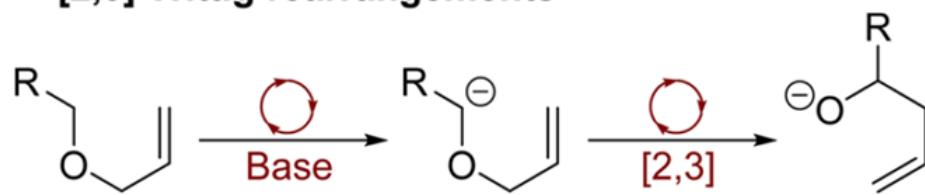
a) Neutral



b) Anionic

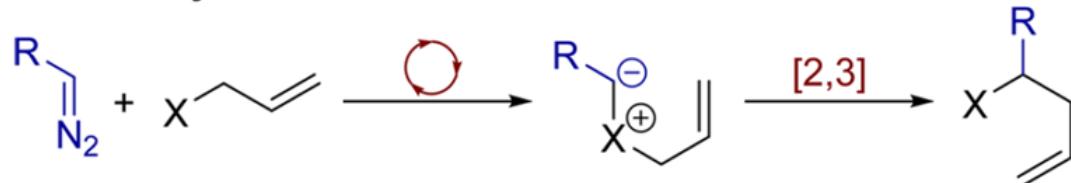


[2,3]-Wittig rearrangements



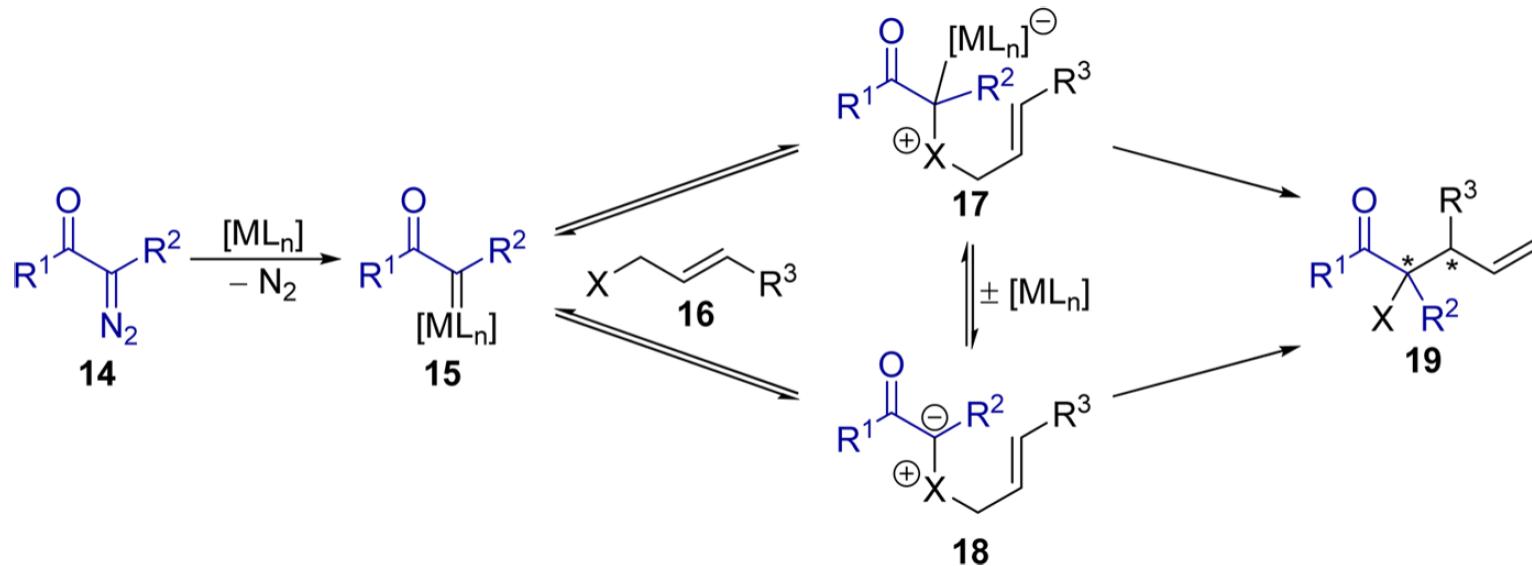
Metal-catalyzed onium Ylide formation and [2,3]- rearrangement

Onium ylides from metal carbenoids



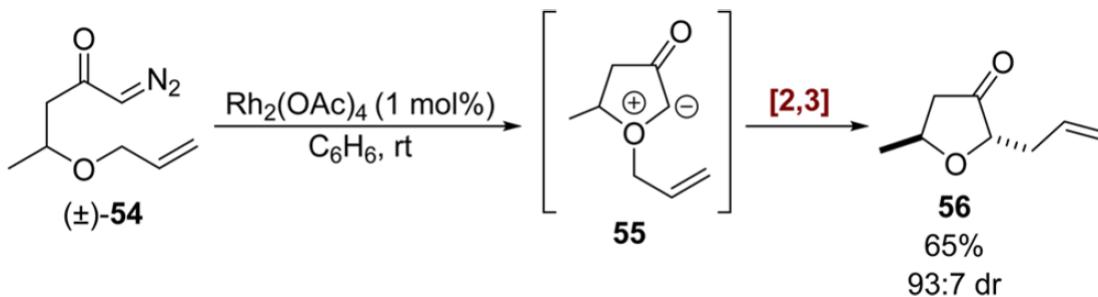
$\text{X} = \text{R}_2\text{N}, \text{RO}, \text{RS}$, halogen

Onium ylides generated from metal carbenoids 15 and subsequent [2,3] rearrangement
($\text{X} = \text{R}_2\text{N}, \text{RO}, \text{RS}, \text{RSe}, \text{Br}$, or I)

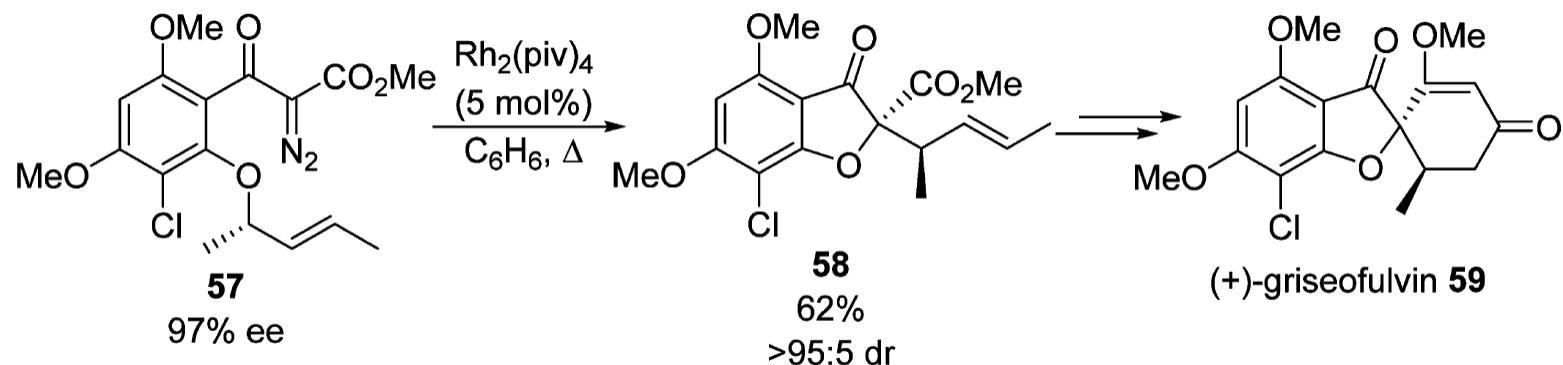


Metal-catalyzed onium Ylide formation and [2,3]- rearrangement

Rearrangement of oxonium ylide 55 generated from alkoxy-substituted diazoketone 54

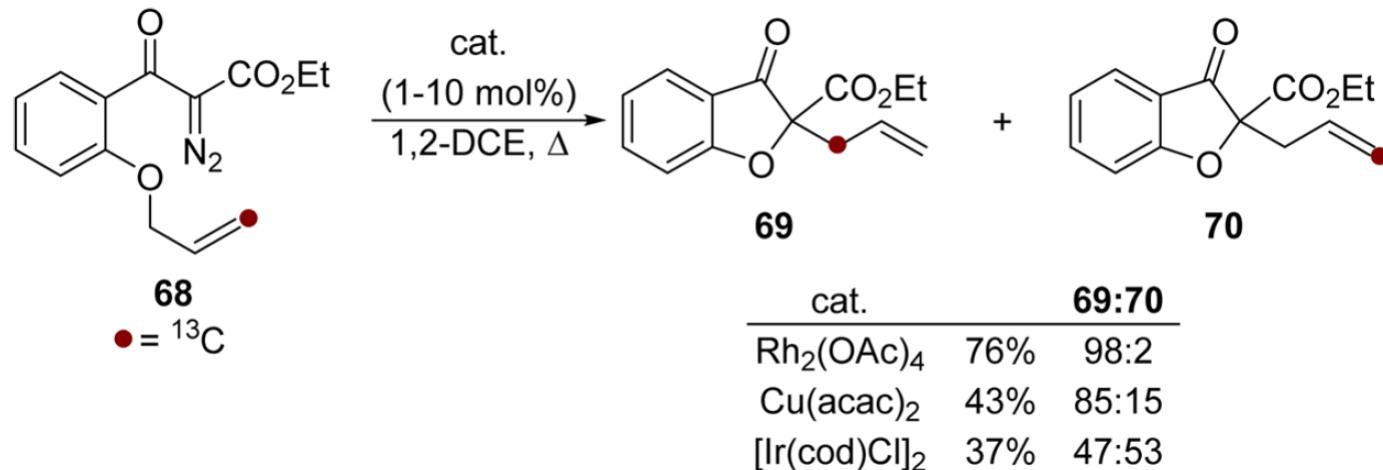


Enantioselective synthesis of (+)-griseofulvin **59**



Metal-catalyzed onium Ylide formation and [2,3]- rearrangement

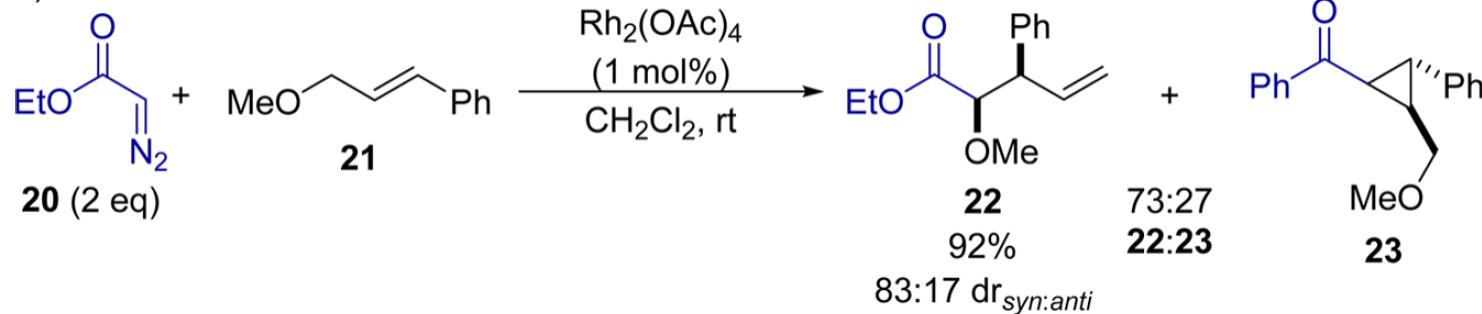
Isotopic substitution suggests metal-bound non-ylide mechanistic pathways



Metal-catalyzed onium Ylide formation and [2,3]- rearrangement

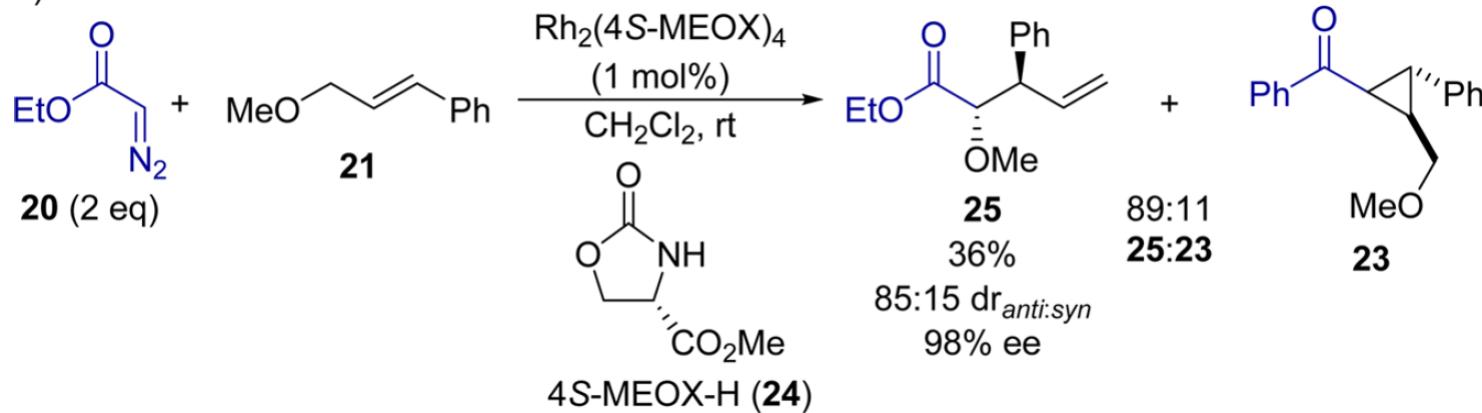
Diastereoselective intermolecular oxonium ylide formation and [2,3]-rearrangement

a)



Enantioselective version using oxazolidin-2-one **24** as a ligand

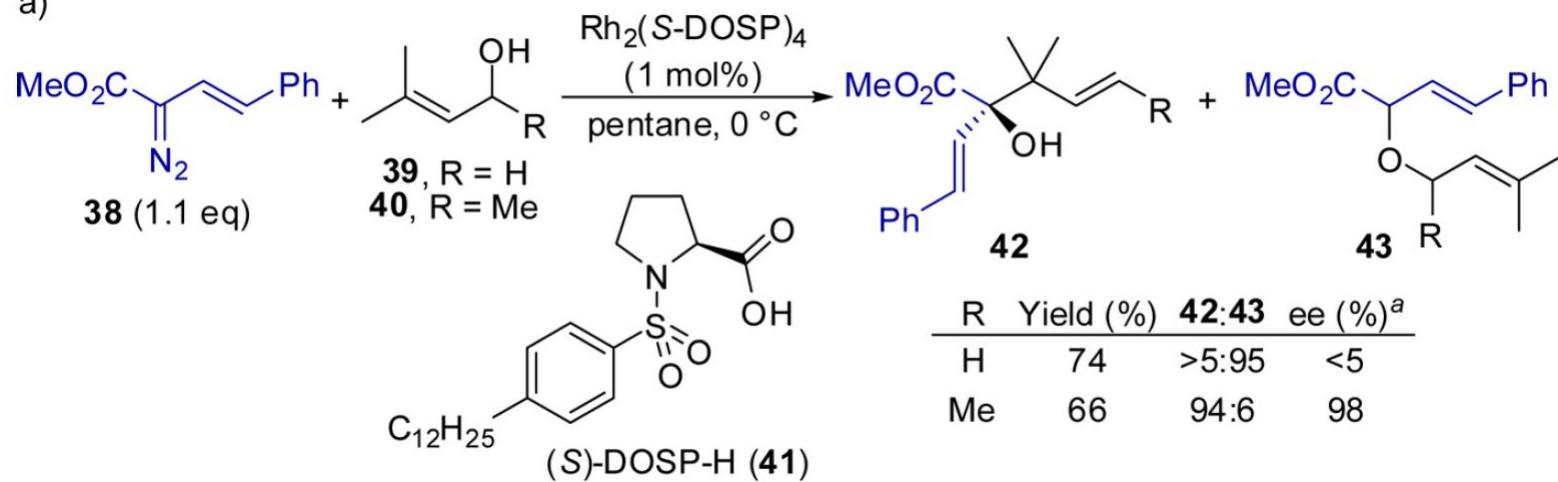
b)



Metal-catalyzed onium Ylide formation and [2,3]- rearrangement

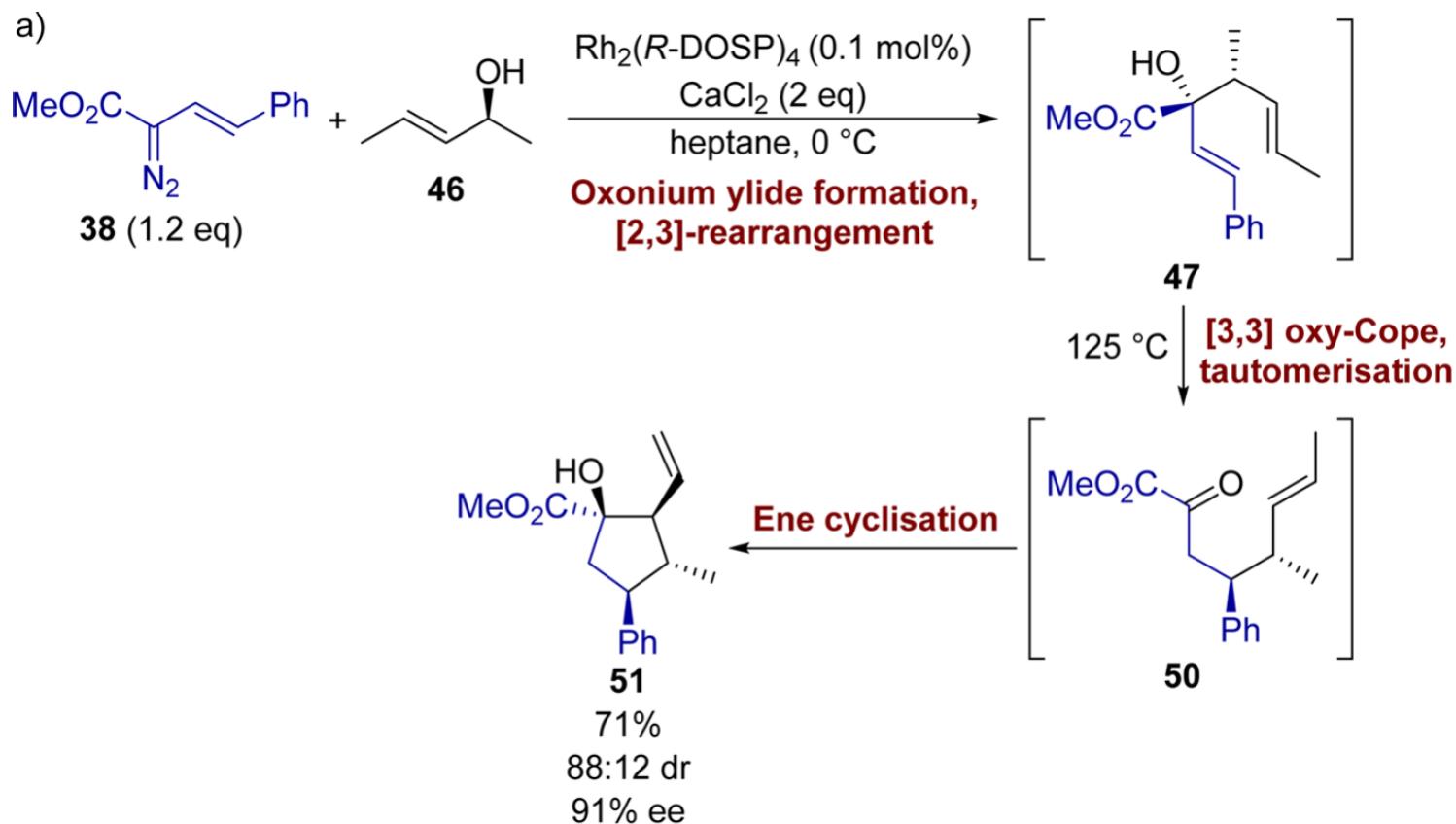
Enantioselective [2,3]-rearrangement reactions using racemic allylic alcohols

a)



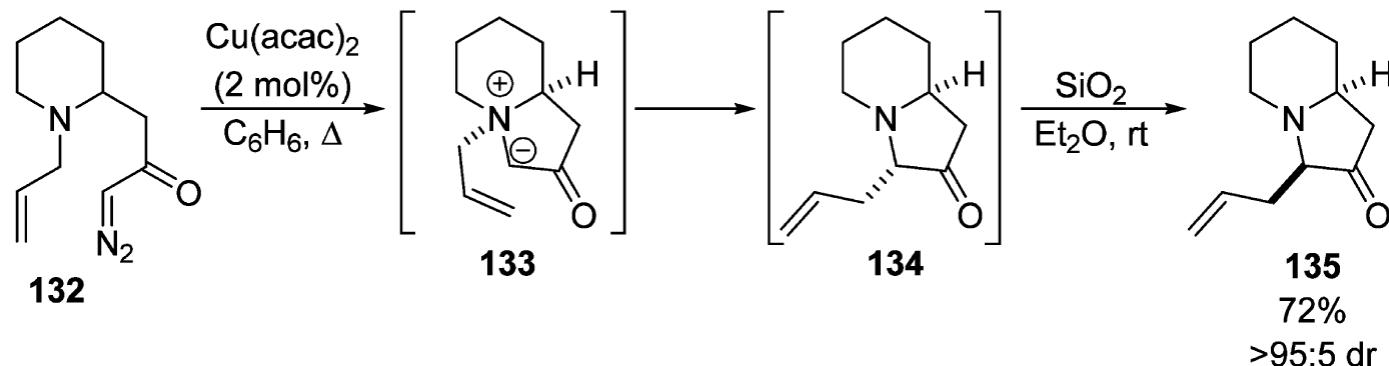
Metal-catalyzed onium Ylide formation and [2,3]- rearrangement

Domino reaction sequence for the synthesis of cyclopentanes

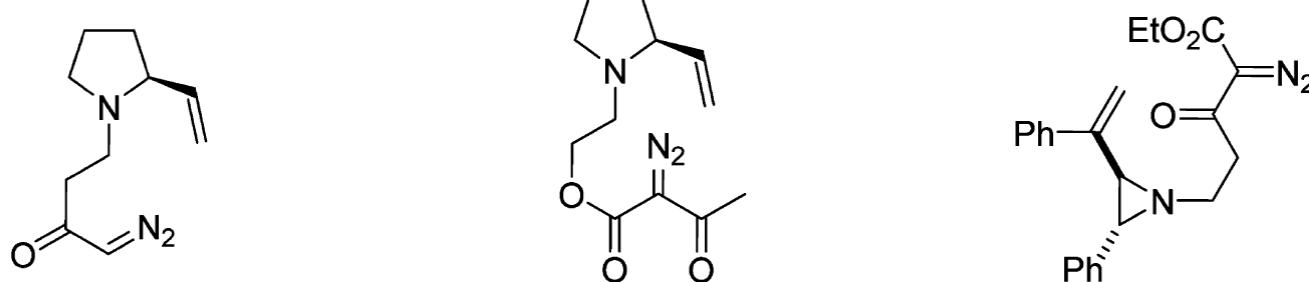


Metal-catalyzed onium Ylide formation and [2,3]- rearrangement

Diastereoselective synthesis of indolizidines via intramolecular ylide generation and [2,3]-rearrangement

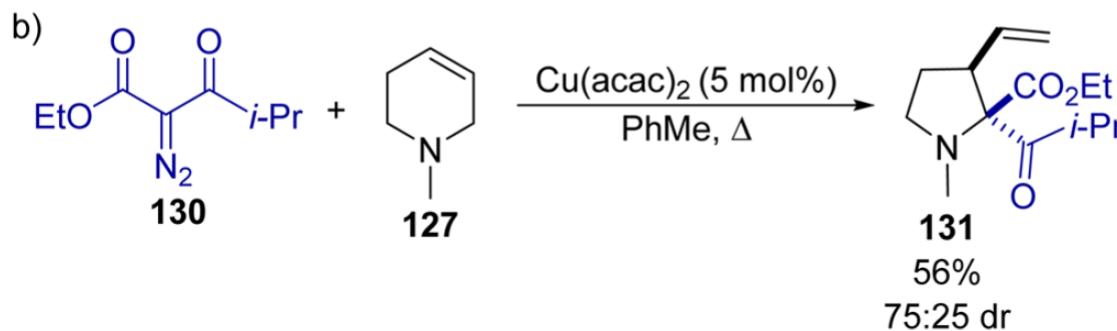
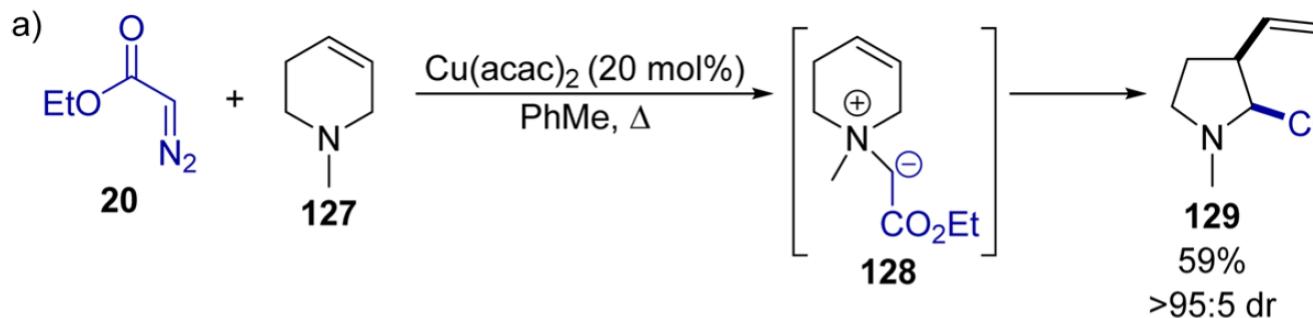


Intramolecular example



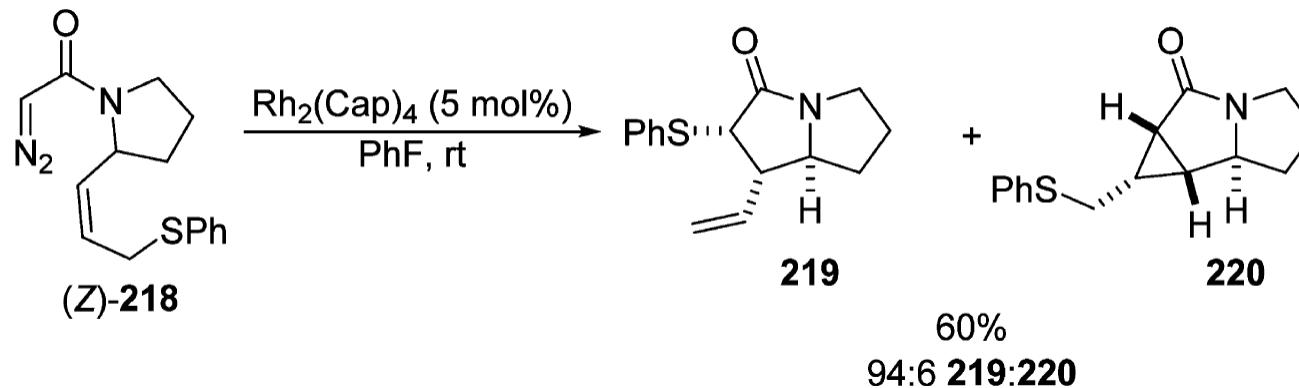
Metal-catalyzed onium Ylide formation and [2,3]- rearrangement

Copper-catalyzed synthesis of substituted pyrrolidines

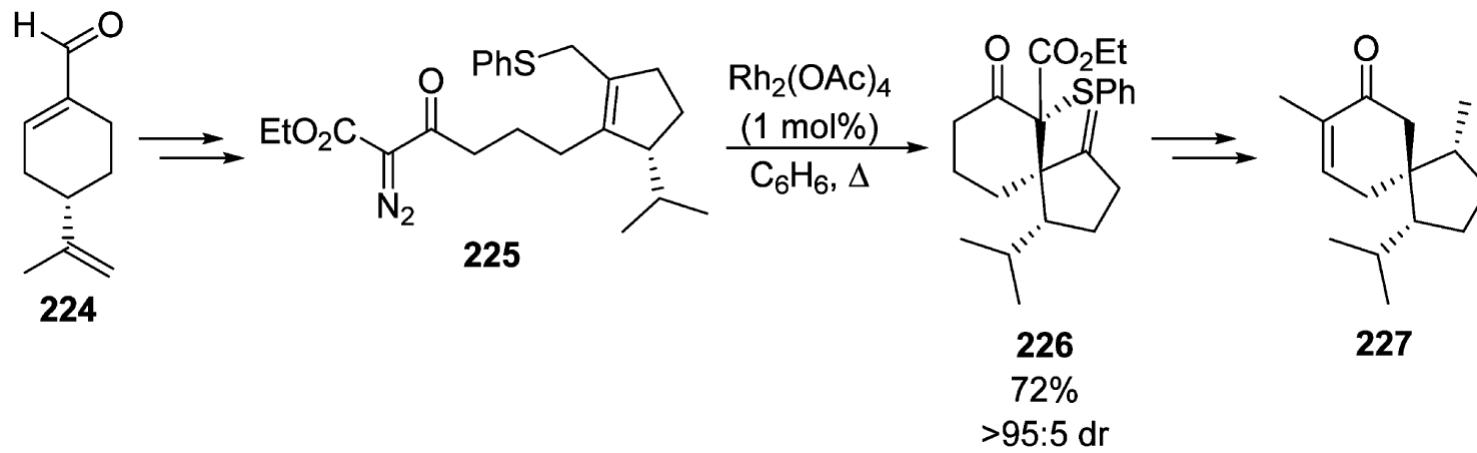


Metal-catalyzed onium Ylide formation and [2,3]- rearrangement

Stereospecific synthesis of substituted pyrrolizine cores

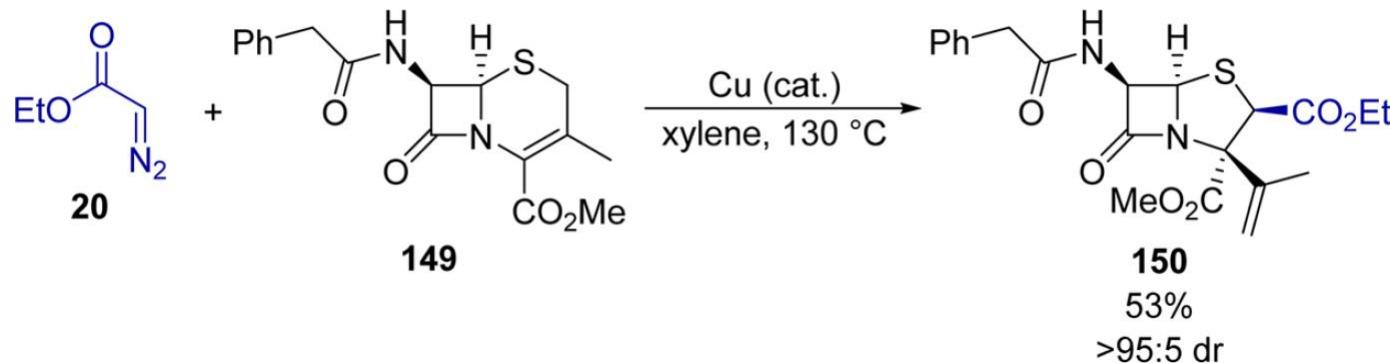


Synthesis of spirocyclic sesquiterpene (+)-Acorenone B

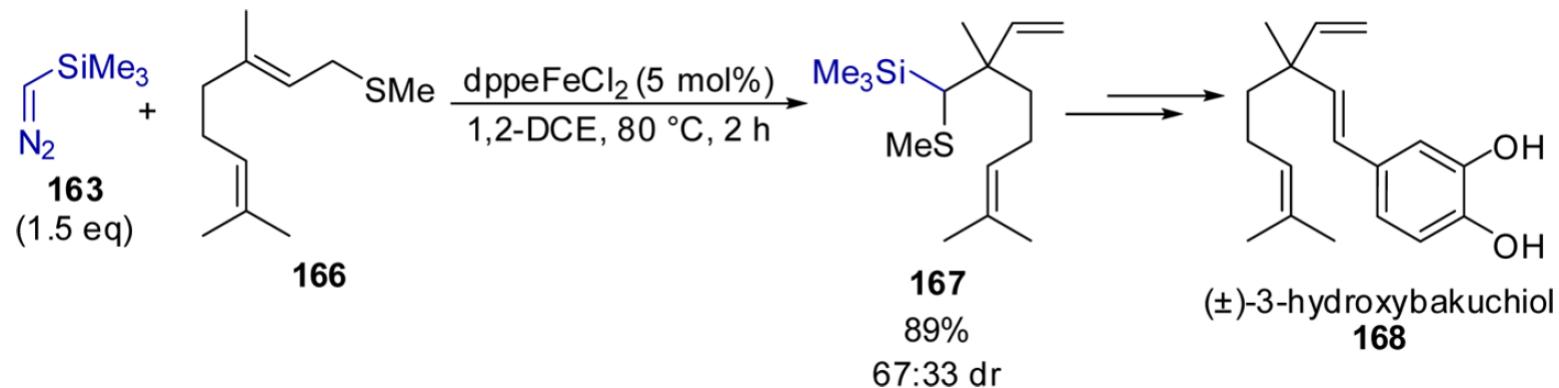


Metal-catalyzed onium Ylide formation and [2,3]- rearrangement

Ring-contraction of cephalosporin core into a penicillin derivative



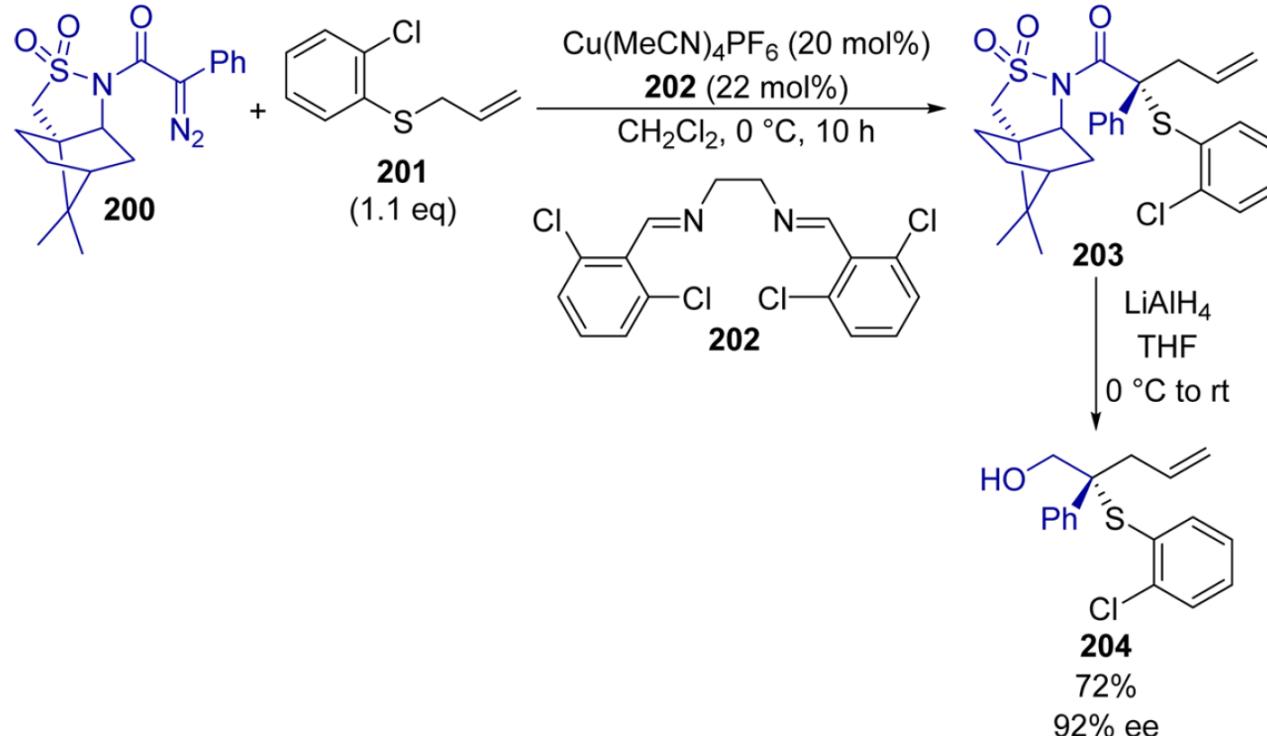
Synthesis of (\pm)-3-Hydroxybakuchiol



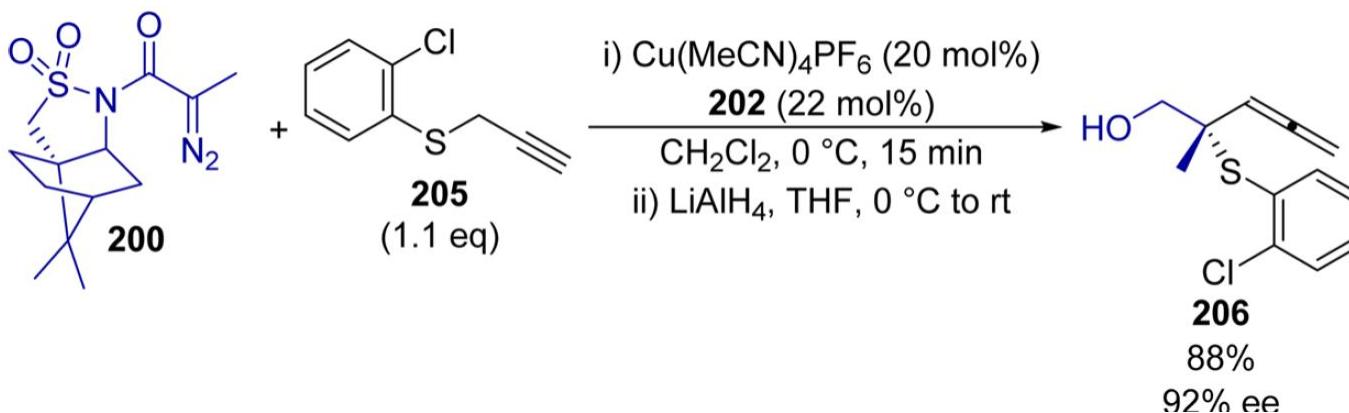
Metal-catalyzed onium Ylide formation and [2,3]- rearrangement

Auxiliary controlled reactions of (a) allylic and (b) propargyl sulfides

a)

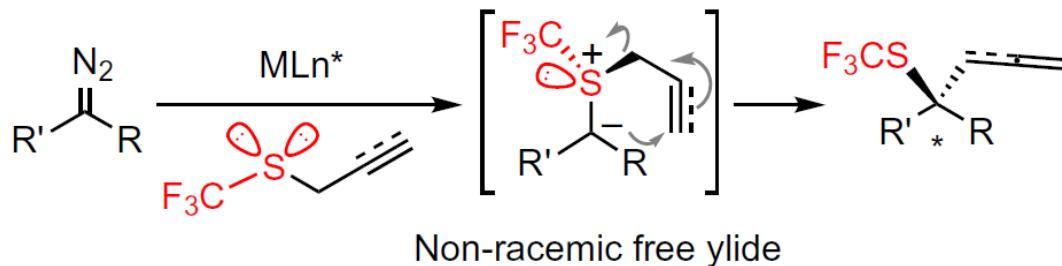


b)

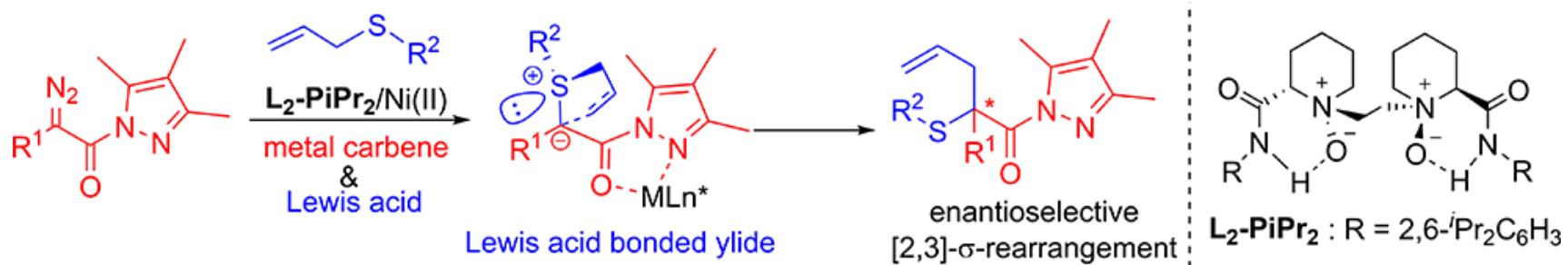


Metal-catalyzed onium Ylide formation and [2,3]- rearrangement

Catalytic asymmetric trifluoromethylthiolation



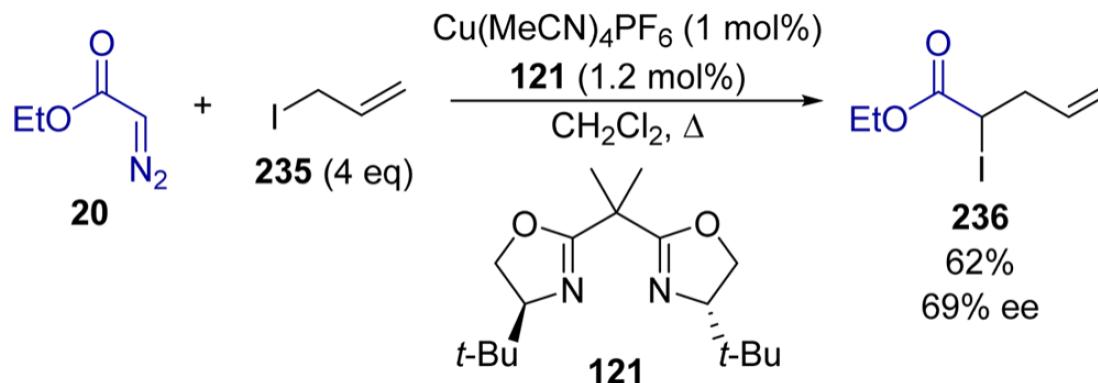
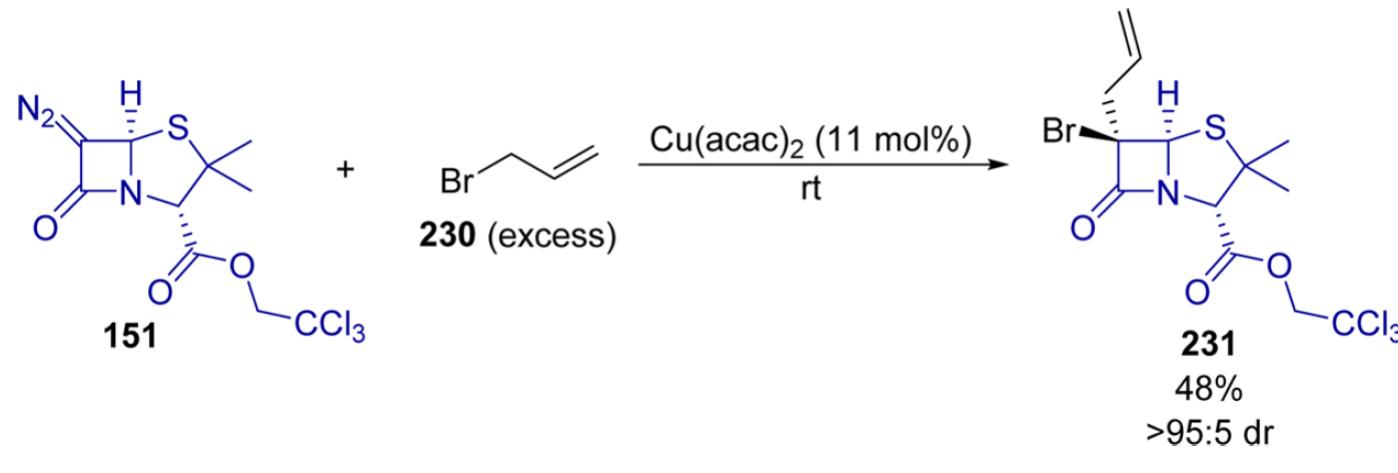
Chiral Nickel(II) complex catalyzed enantioselective Doyle–Kirmse reaction of α -diazo pyrazoleamides



$\text{R}^1 = \text{Ar, CH=CHR}$; $\text{R}^2 = \text{Ar, allyl, alkyl}$. $\text{R} = \text{H, alkyl, Ar}$. $\text{MLn}^* = \text{L}_2\text{-PiPr}_2/\text{Ni(II)}$
34 examples; 46–99% yields; 61–96% ee; 5–20 min in most cases

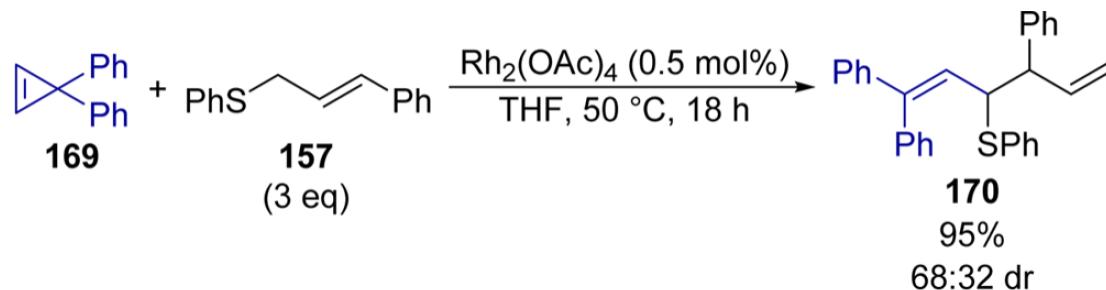
Metal-catalyzed onium Ylide formation and [2,3]- rearrangement

Catalytic halonium ylide formation from diazopenicillanate

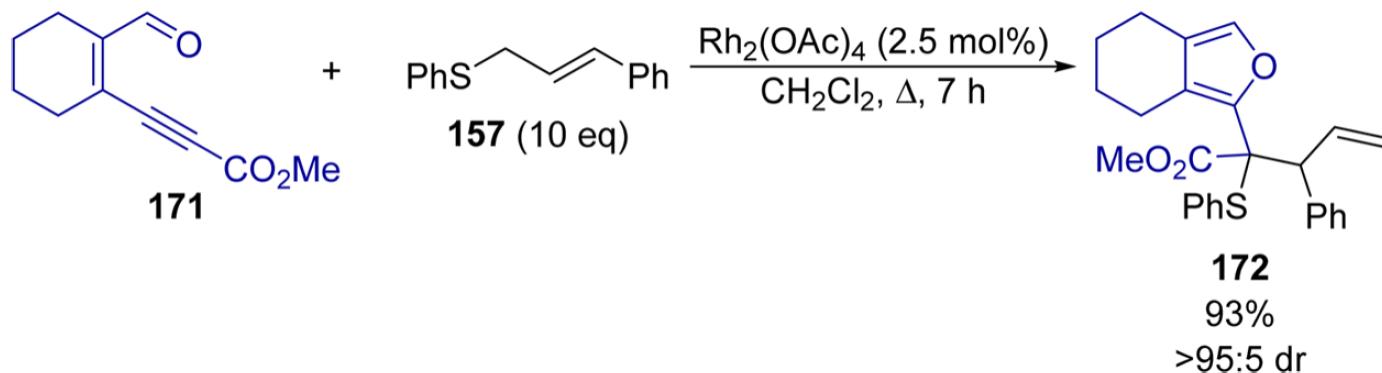


Metal-catalyzed onium Ylide formation and [2,3]- rearrangement

Use of cyclopropenes as rhodium carbenoid precursors

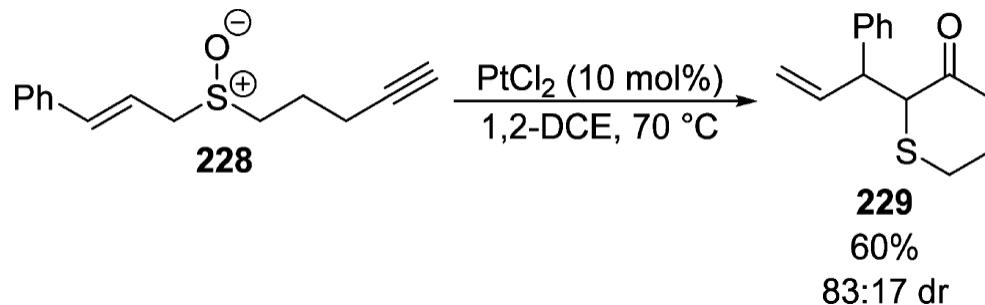


Use of substituted alkynes as rhodium carbenoid precursors

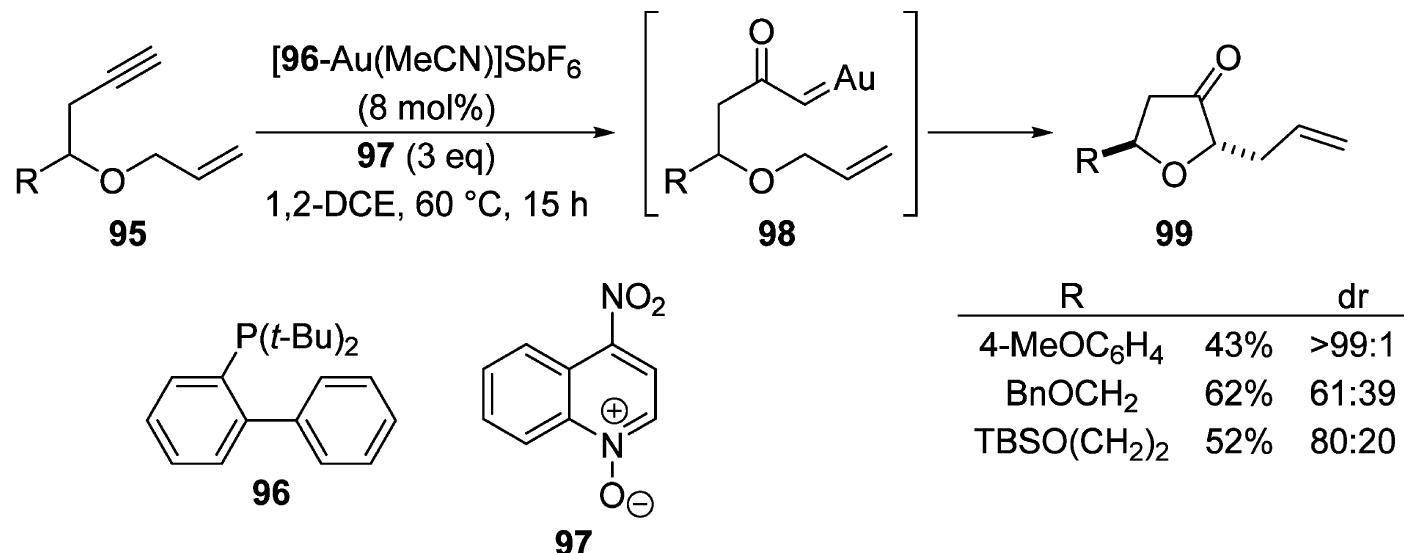


Metal-catalyzed onium Ylide formation and [2,3]- rearrangement

Tethered sulfoxides and alkynes as sulfonium ylide precursors

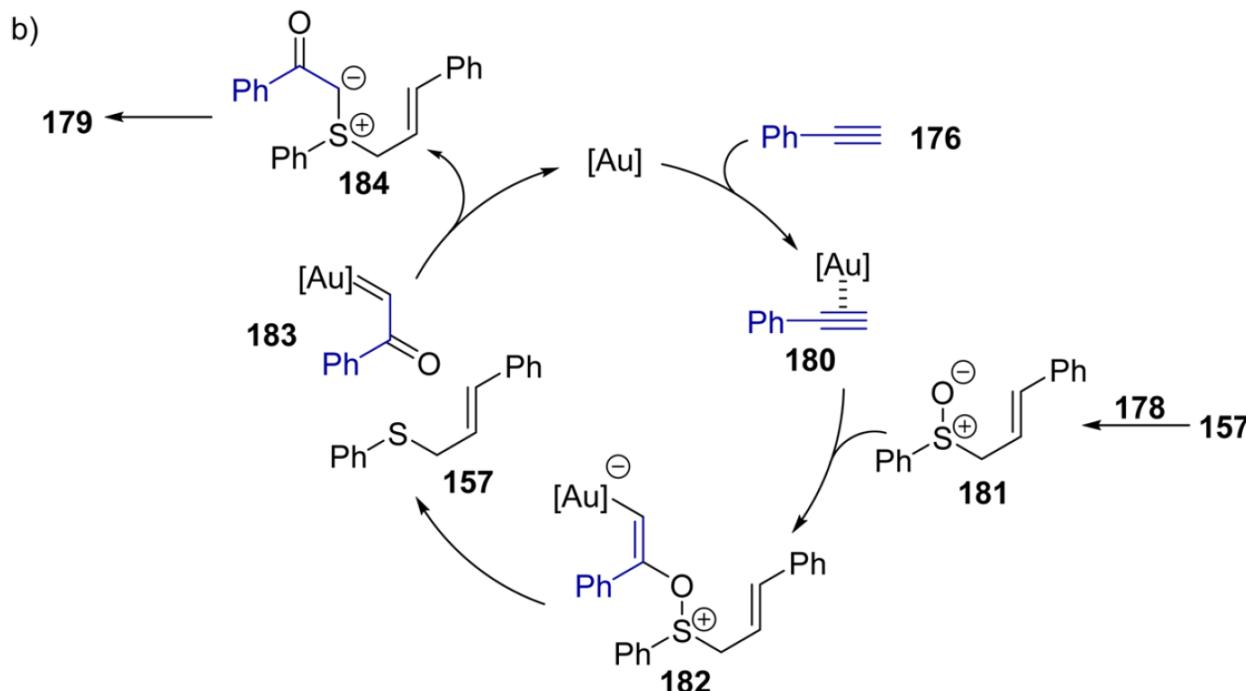
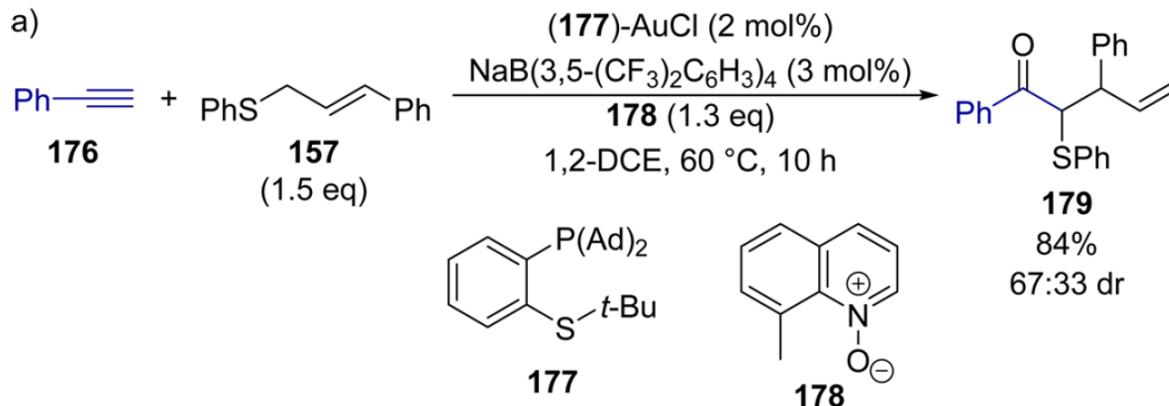


Alkynes as Gold Carbenoid Precursors



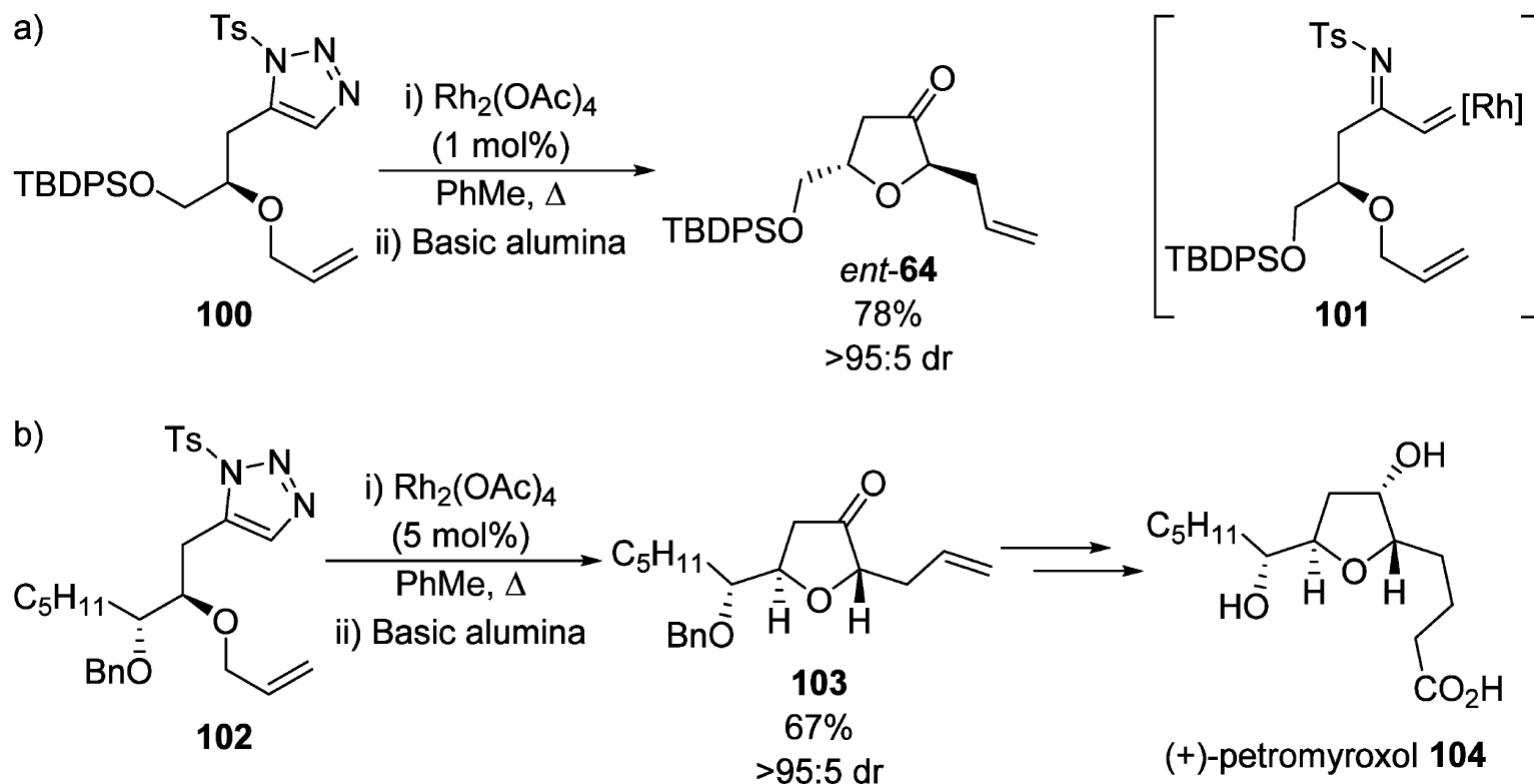
Metal-catalyzed onium Ylide formation and [2,3]- rearrangement

Alkynes as metal carbenoid precursors



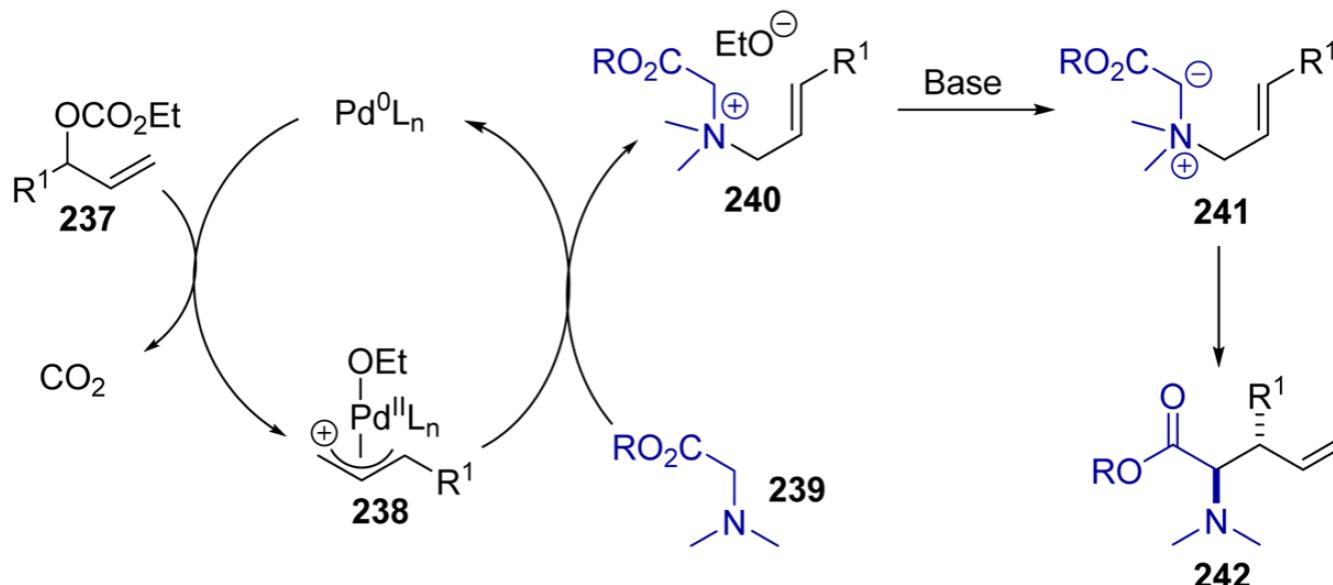
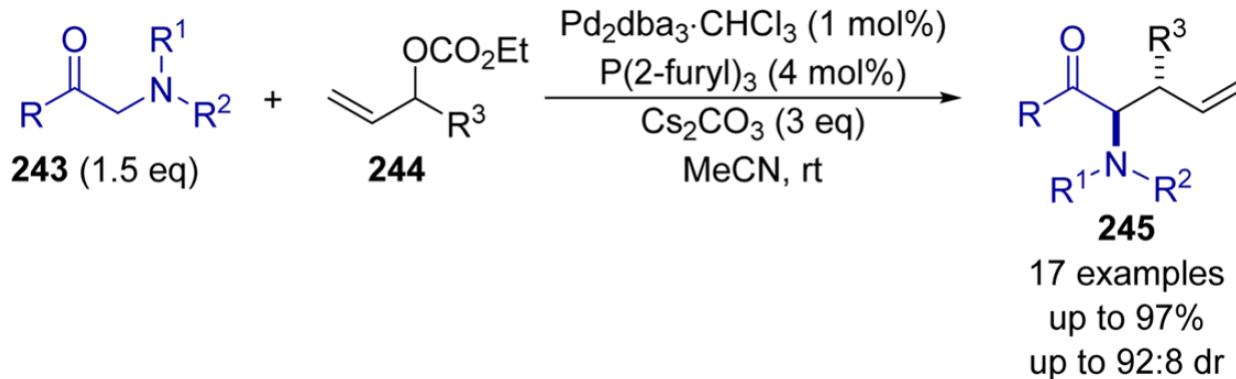
Metal-catalyzed onium Ylide formation and [2,3]- rearrangement

- (a) Diastereoselective synthesis of dihydrofuran-3-imines from N-Tosyl 1,2,3-triazoles
(b) Application in natural product synthesis



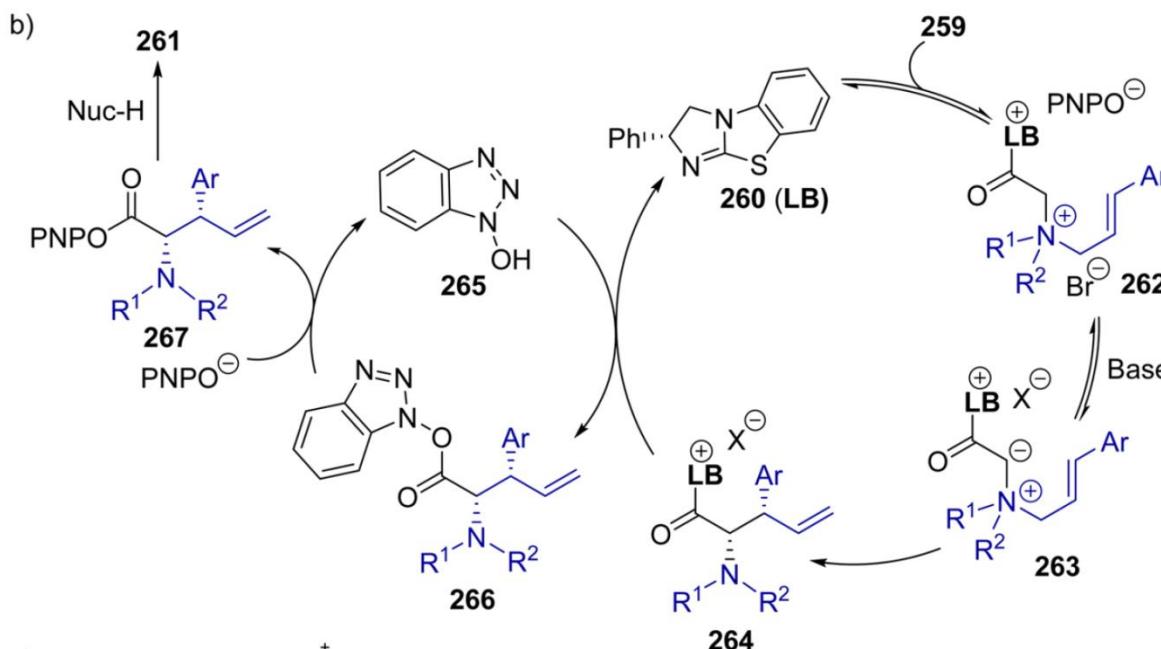
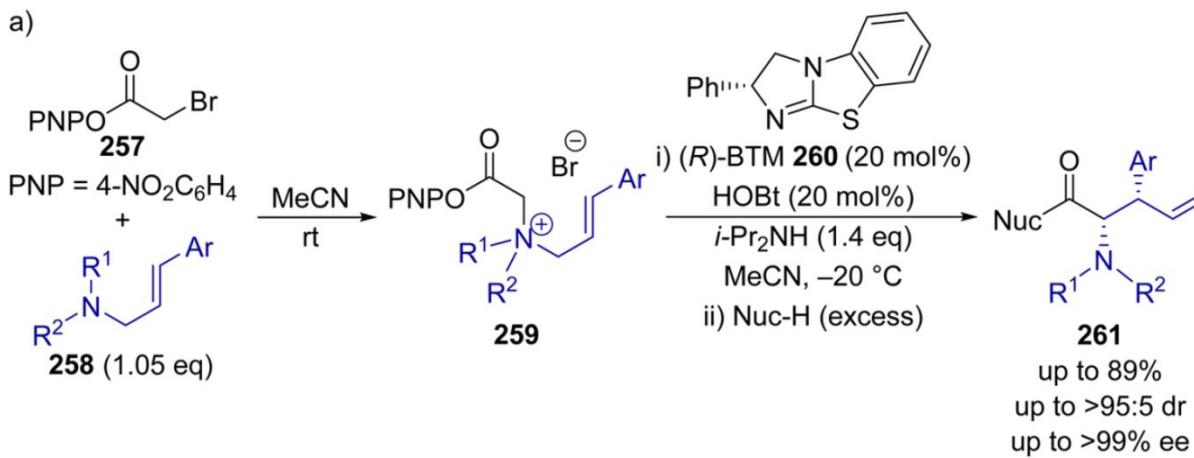
[2,3]-Rearrangements of ammonium ylides from allylic quaternary salts

Palladium-catalyzed allylic amination to form [2,3]-rearrangement precursors



[2,3]-Rearrangements of ammonium ylides from allylic quaternary salts

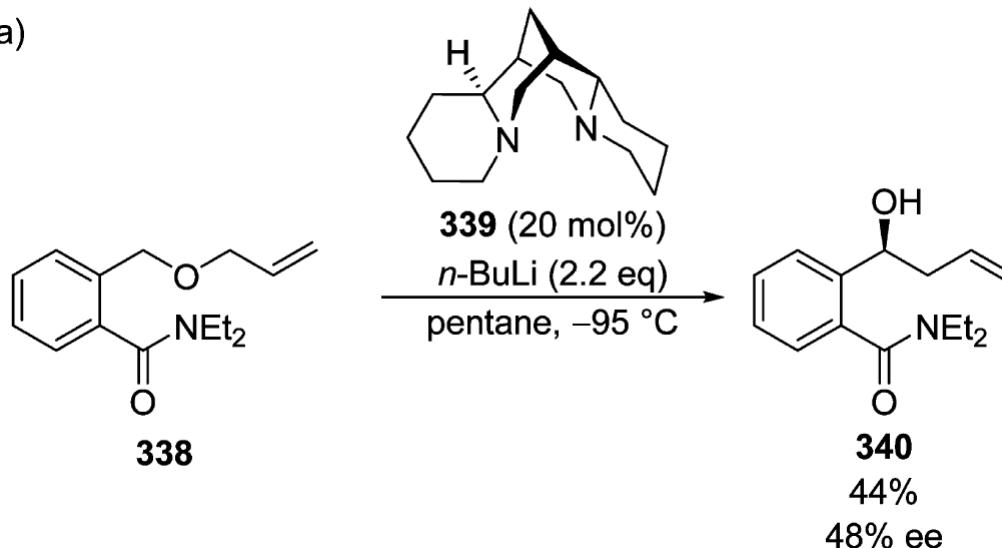
Organocatalytic stereoselective [2,3]-rearrangement of allylic ammonium salts



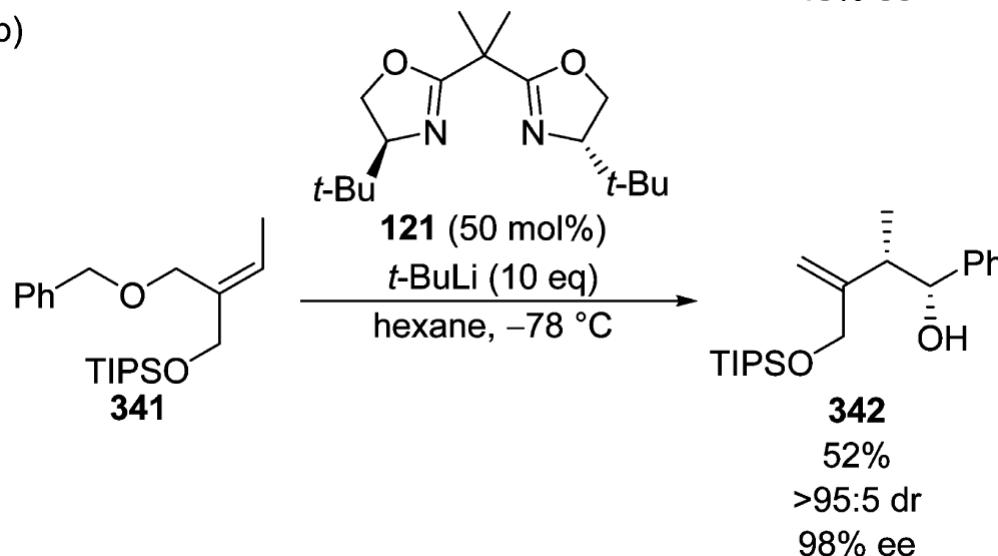
Catalytic [2,3]-Wittig rearrangements

Asymmetric base-mediated [2,3]-Wittig rearrangements using catalytic chiral ligands

a)

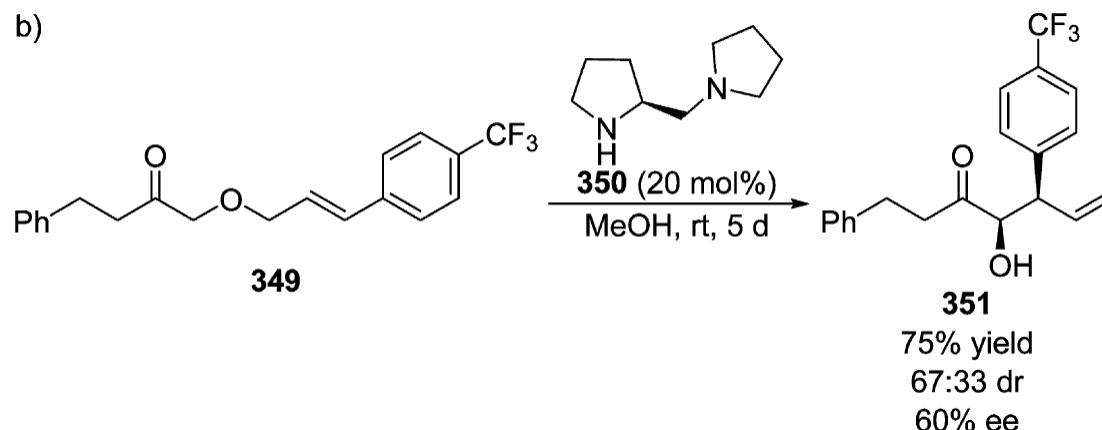
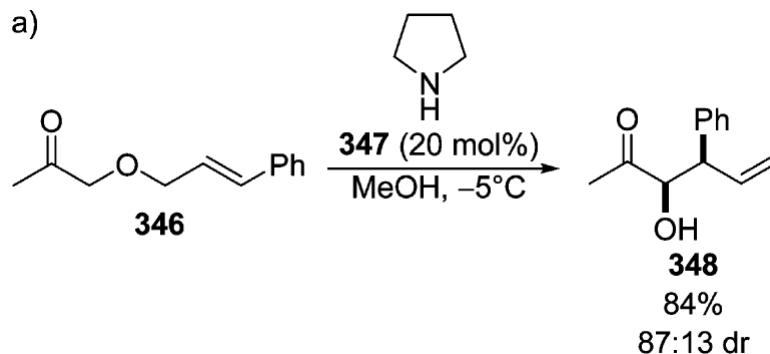


b)



Catalytic [2,3]-Witting rearrangements

Stereoselective organocatalytic [2,3]-Wittig rearrangements



Summary

[2,3]-Rearrangement of onium ylides generated catalytically through reaction of a metal carbenoid remains the most widely explored methodology in the area

Limited detailed mechanistic understanding of many of these processes

An increasing number of alternative catalytic strategies available using different methods of accessing reactive intermediates capable of undergoing stereoselective [2,3]-rearrangements

THANKS

