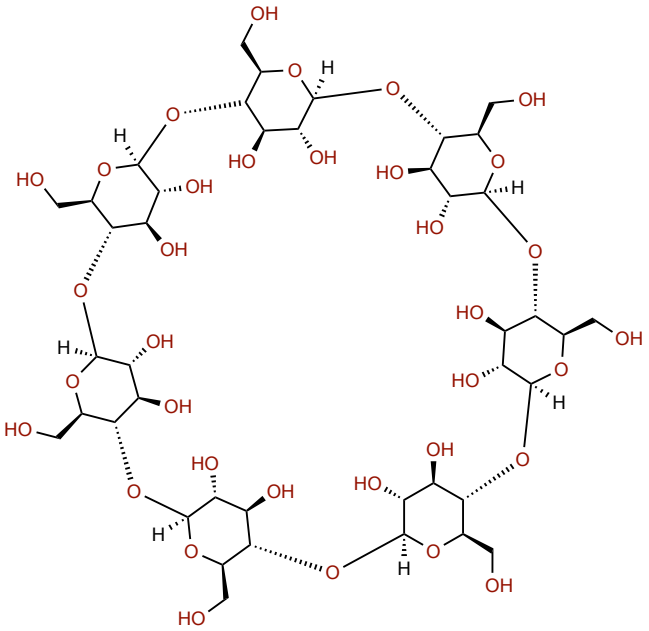
β-Cyclodextrins

- Macrocyclic oligosaccharides consisting of 1,4 linked glucose units
- Utilized as host molecule in supramolecular chemistry
- Commercially available, water-soluble natural products
- Often used as artificial enzymes, chiral separators, and chemical sensors
- Possess hydrophobic and chiral interior cavities that readily host small organic molecules
- Can be used directly as catalysts, or further modified
- Most typically form a 1:1 host:guest complex
- Can also be done in solid state
- Utilized in push towards “green” chemistry

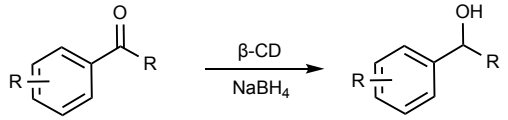


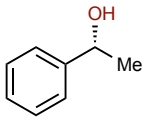
Enzyme Model:
- Cyclodextrin catalyzed
- Most often through covalent bonding
- Forms bonded CD-reactant intermediate

Extra Reaction Field:
- Cyclodextrin mediated
- Does not involve covalent bonding
- Acts as hydrophobic pocket, may change rate or selectivity

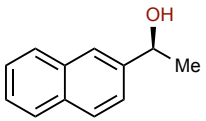
Eur. J. Org. Chem., **2022**, 1-24 doi/10.1002/ejoc.202200904

Ketone Reduction:

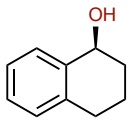




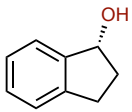
82% yield
4% ee (*R*)



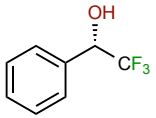
88% yield
23% ee (*S*)



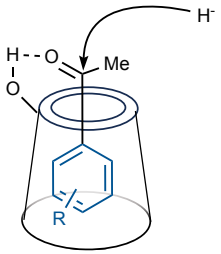
82% yield
22% ee (*S*)



88% yield
2% ee (*R*)



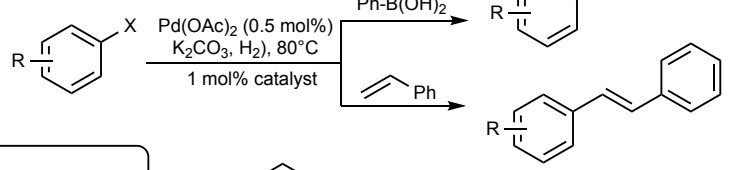
89% yield
24% ee (*R*)

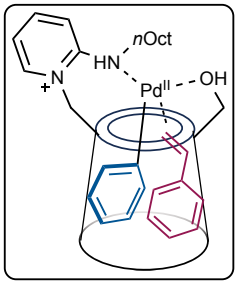


enantioselectivity controlled by size and shape of cavity and hydrophobic interactions (highly substrate dependent)

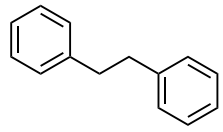
Journal of Inclusion Chemistry, **1997**, 41-48

Cross Coupling:

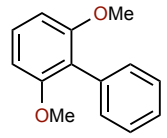




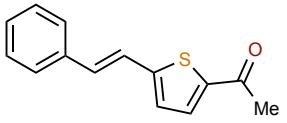
Pyridinium modified β-cyclodextrin



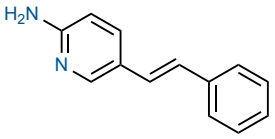
84%



90%



88%

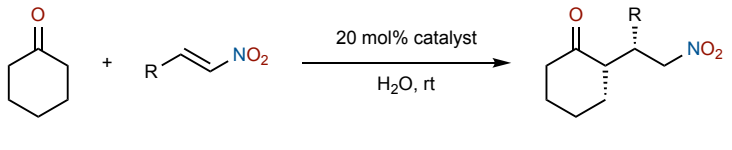


90%

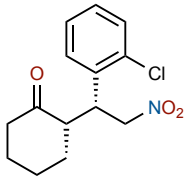
Green Chem., **2016**, 18, 5518 DOI: 10.1039/c6gc01326k

β-Cyclodextrins

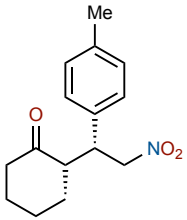
Asymmetric Michael Addition:



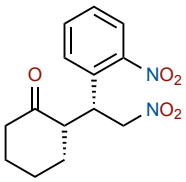
***catalyst**: 2-methylpyrrolidine modified CD*



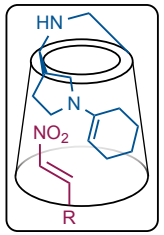
51% yield
91:9 syn:anti
syn: 68% ee; anti: 35% ee



57% yield
99:1 syn:anti
syn: 61% ee

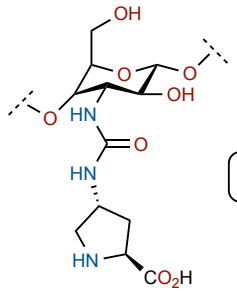


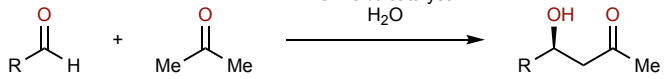
47% yield
97:3 syn:anti
syn: 71% ee



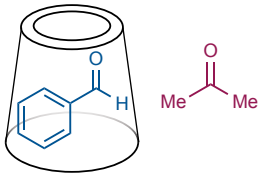
Chinese Journal of Catalysis, **2016**, 37, 1227-1234 doi: 10.1016/S1872-2067(15)61122-6

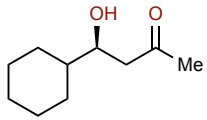
Asymmetric Aldol Reaction:



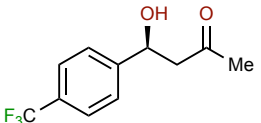


difference in binding constant of substrate leads to variable ee's

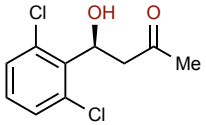




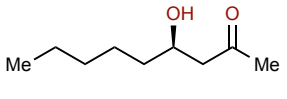
26% yield
99% ee



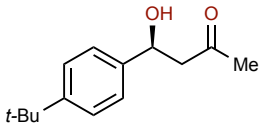
93% yield
80% ee



97% yield
9% ee



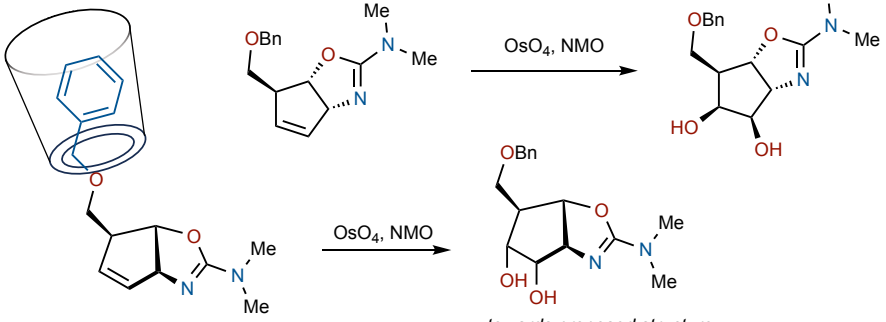
76% yield
91% ee



32% yield
92% ee

Tett. Lett., **2015**, 56, 243-246 doi.org/10.1016/j.tetlet.2014.11.084

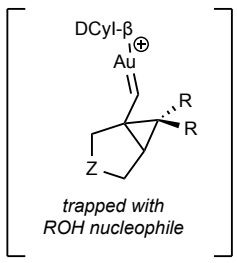
Application in Synthesis:



towards proposed structure of allosamizoline

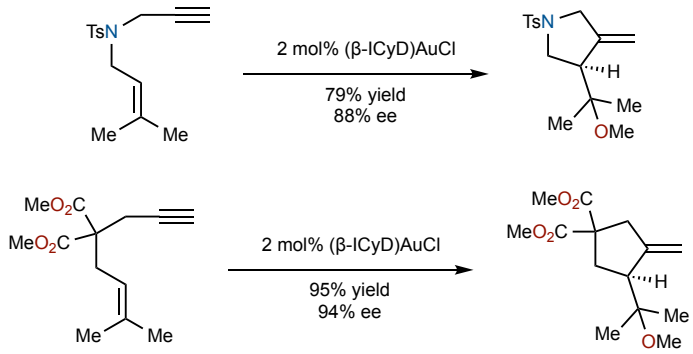
JACS, **1990**, 112, 1261-1263 doi/pdf/10.1021/ja00159a065

Enantioselective Cyclization:



trapped with ROH nucleophile

chiral environment in CD cavity tethered to gold(I) NHC



ACS Catal, **2020**, 10, 5964-5972 doi.org/10.1021/acscatal.0c00127