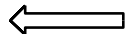
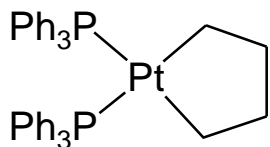
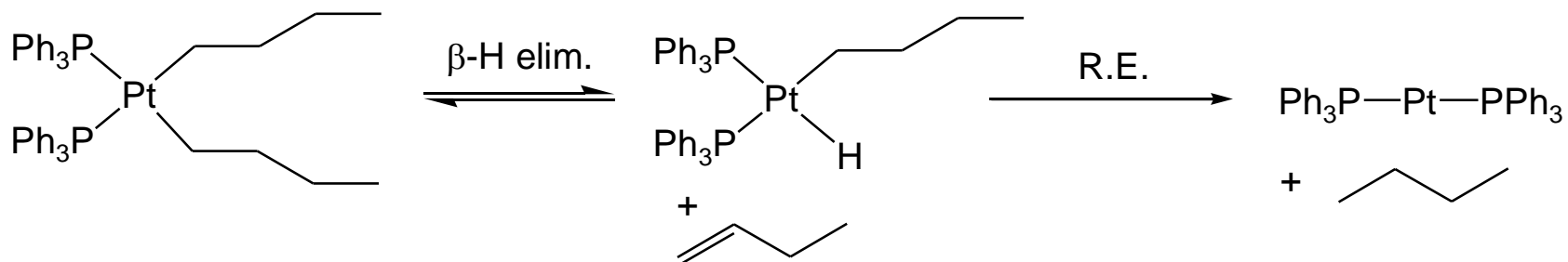


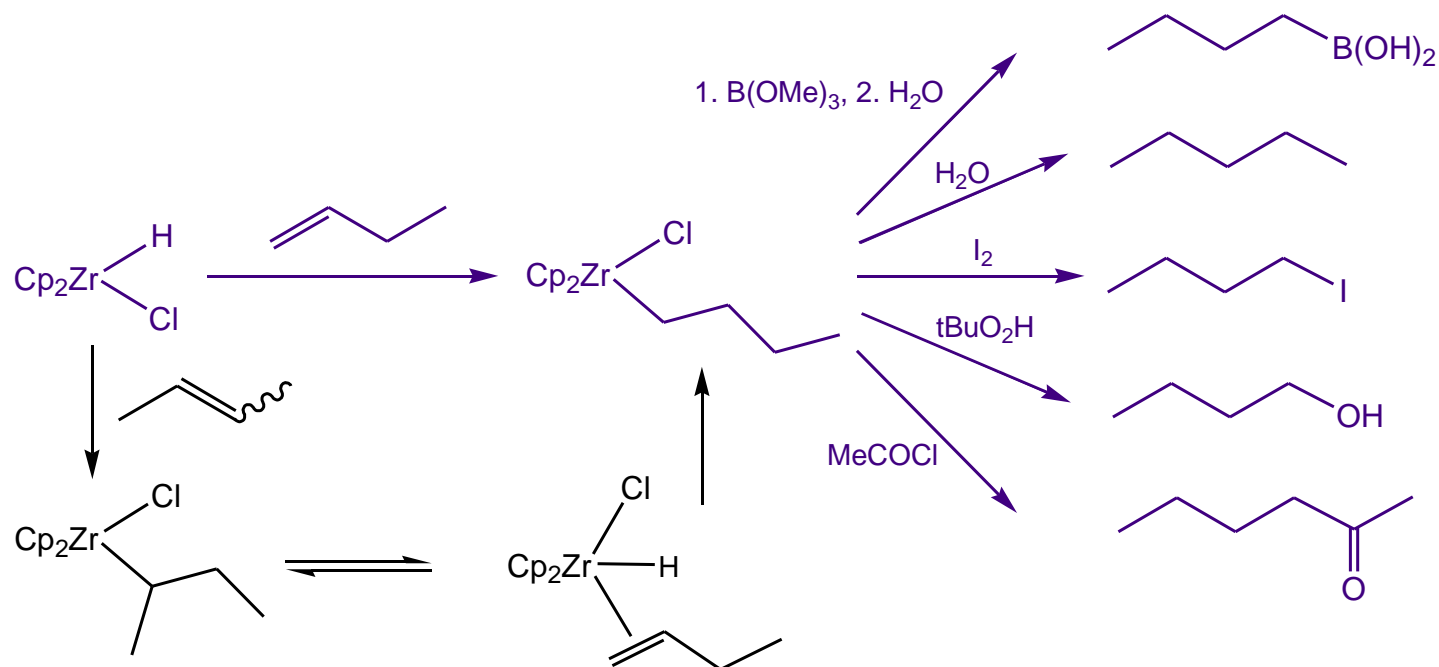
## 1,2-INSERTION / DEINSERTION

- 1,2-Insertion/Deinsertion occurs via a planar 4-centered transition state in which the  $\beta$ -C-H bond and the M-C bond must be approximately coplanar.

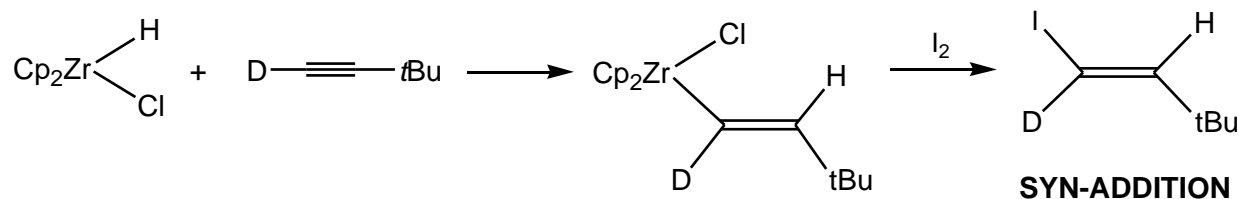


Kinetically  $10^4$  times more stable to decomposition than the dibutyl complex (difficult for the  $\beta$ -C-H bonds to become coplanar with M-C)

# HYDROZIRCONATION – V. useful STOICHIOMETRIC 1,2-insertion reaction

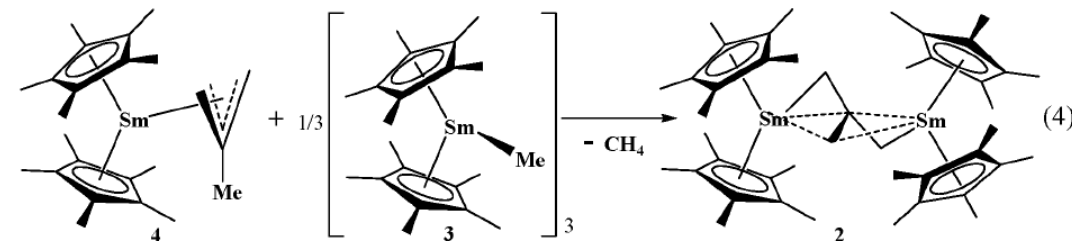
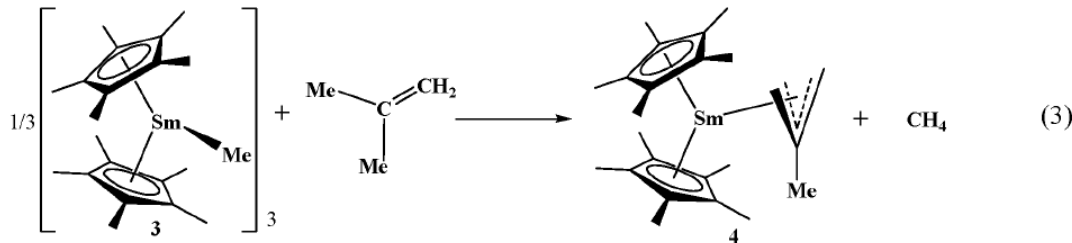
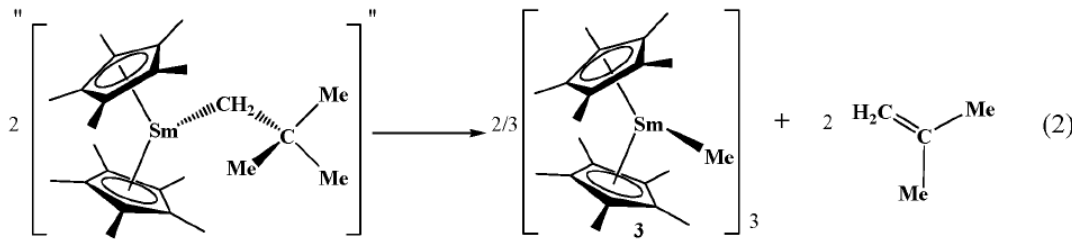


- SYN-addition of Zr–H across a C=C or C≡C bond
- Generally Zr attached to the least sterically hindered position (anti-Markovnikov)

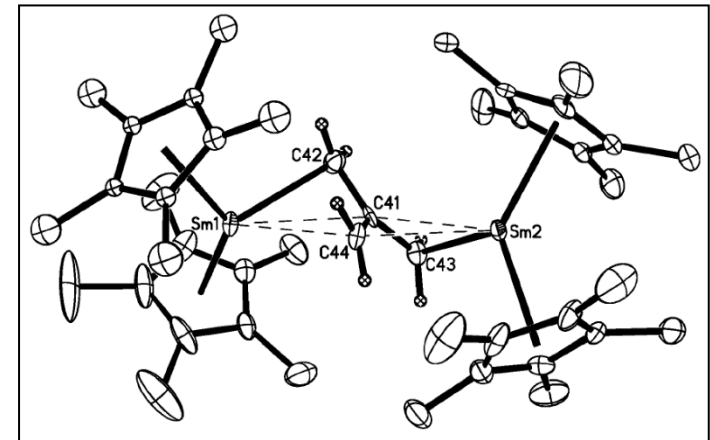


# C-C bond forming / breaking 1,2-INSERTION / DEINSERTION

- 1,2-Insertion is a very important way to build carbon chains (polyethylene etc.)
- Polymerization = thermodynamically favourable  
= often not observed due to kinetics or  $\beta$ -H elim. (termination)
- $\beta$ -Me elimination = much more rare than  $\beta$ -H elimination  
= a bit more common for f-block elements (stronger M-R bonds)



Evans, *JACS*, 2005, 1068



# C-C bond forming / breaking 1,2-INSERTION / DEINSERTION

- Key experiment by Bergman :

