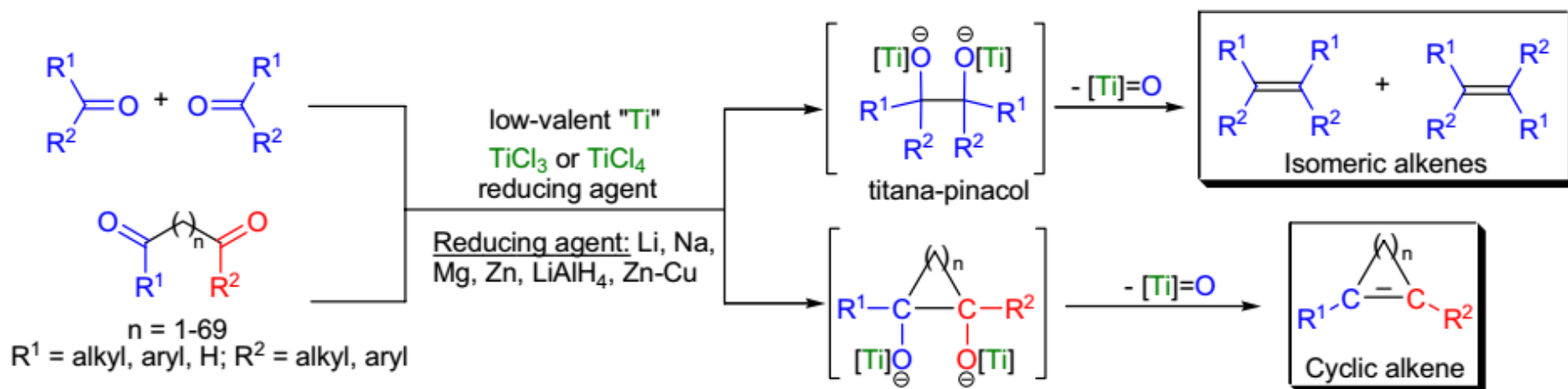


McMURRY COUPLING

Ming-Liang Lou

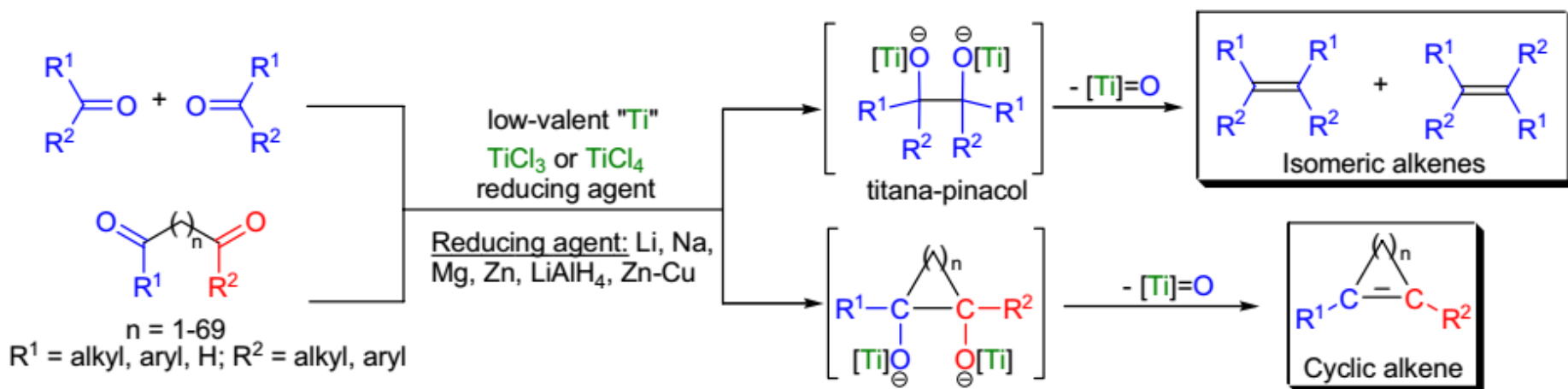
05/10/2016

1. What Is McMURRY COUPLING

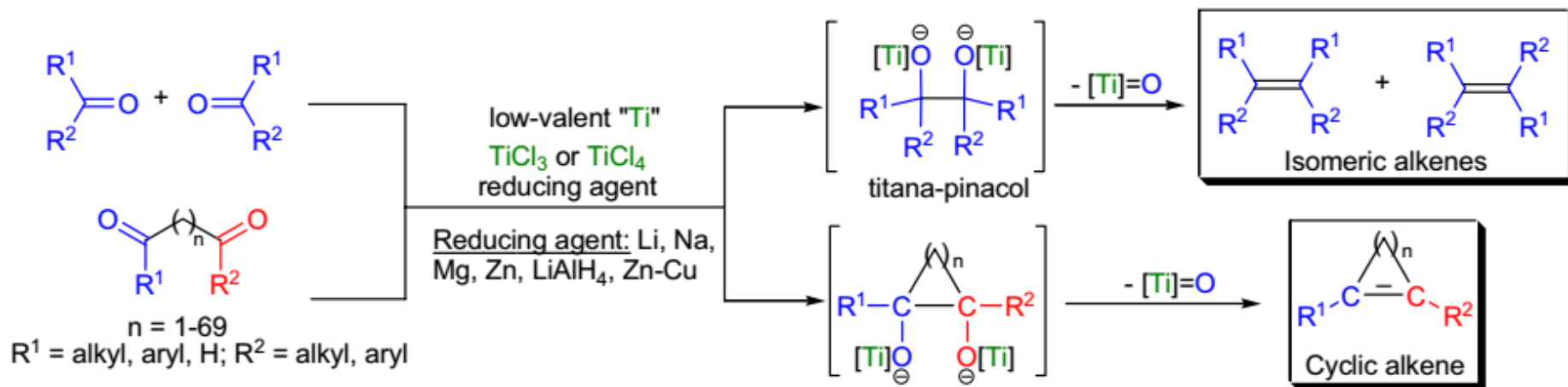


The reductive coupling of carbonyl compounds using low-valent titanium complexes to form the corresponding alkenes is known as the McMurry coupling

2. Features of McMURRY COUPLING



- 1) it is used most often for the homocoupling of aldehydes and ketones to afford alkenes. However, mixed coupling is feasible if one component is used in excess or one of the coupling partners is a diaryl ketone;
- 2) aldehydes react much faster than ketones so the coupling of two aldehydes in the presence of a ketone can be performed chemoselectively;
- 3) macrocyclization under high dilution conditions is successful for the synthesis of medium and large rings and the yields are independent of the ring size unlike in other macrocyclizations (e.g., acyloin condensation);
- 4) intramolecular reactions are the fastest for the formation of five- and six membered rings and the formation of eight- or higher-membered rings is considerably slower;



5) the low-valent titanium reducing agent can be prepared in many ways but the most common is the reduction of TiCl_3 with a zinc-copper couple (Zn-Cu) in DME

6) if the reaction is conducted at low temperature, the pinacol intermediate may be isolated; at high temperature the alkenes are formed directly;

7) the reaction conditions do not tolerate the presence of easily reducible functional groups (e.g., epoxides, allylic and benzylic alcohols, quinones, halohydrins, aromatic and aliphatic nitro compounds, oximes, and sulfoxides);

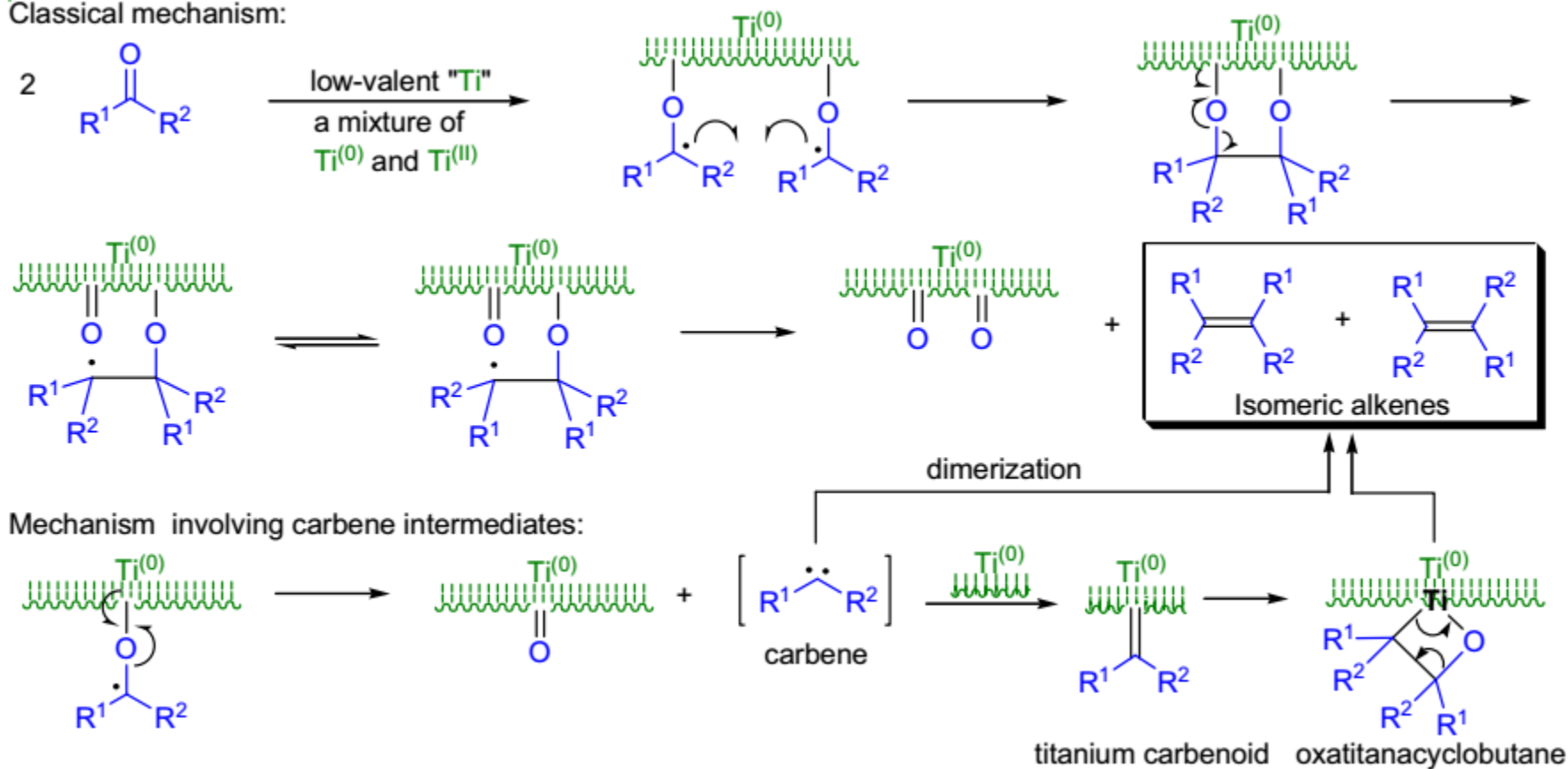
8) sterically hindered and/or strained olefins, even sterically hindered tetrasubstituted alkenes can be prepared;

9) the alkene product is formed with poor stereoselectivity, although there is a slight preference for the formation of (E)-alkenes in intermolecular reactions;

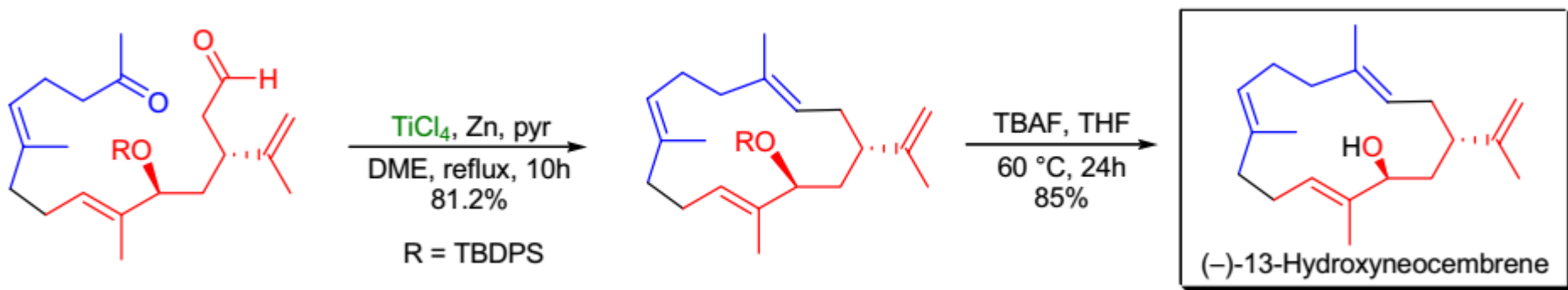
10) in the presence of a chlorosilane the McMurry reaction becomes catalytic

3. Mechanisms of McMURRY COUPLING

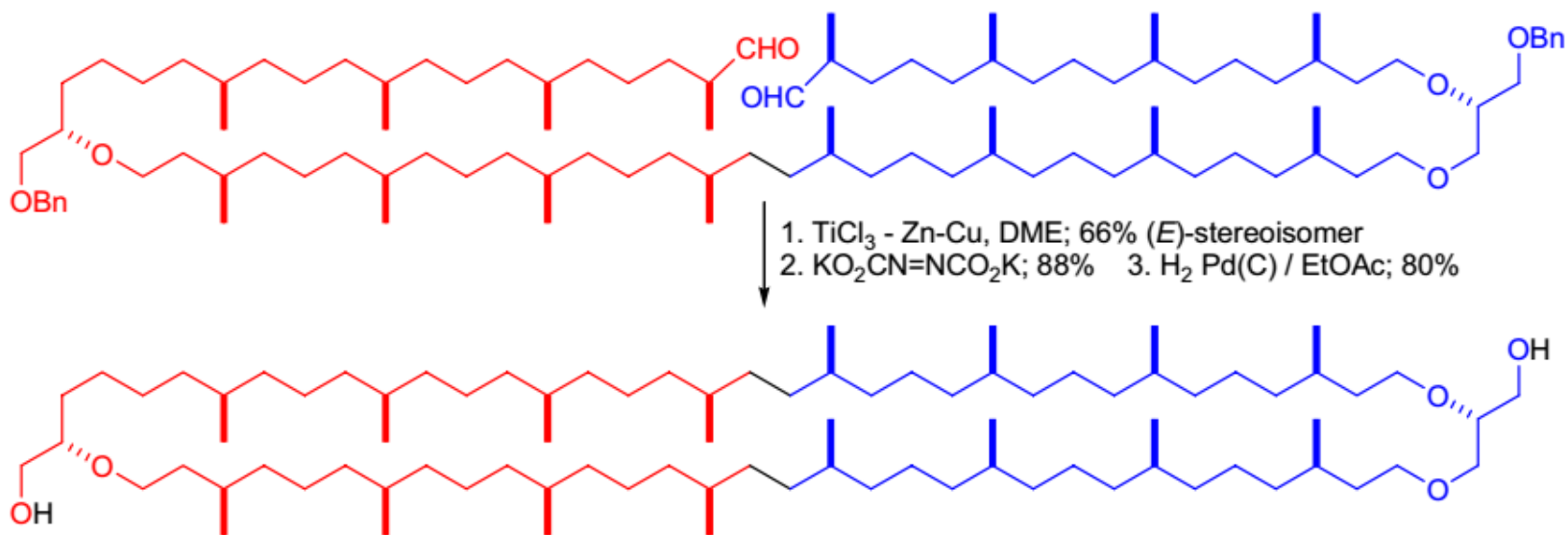
Classical mechanism:

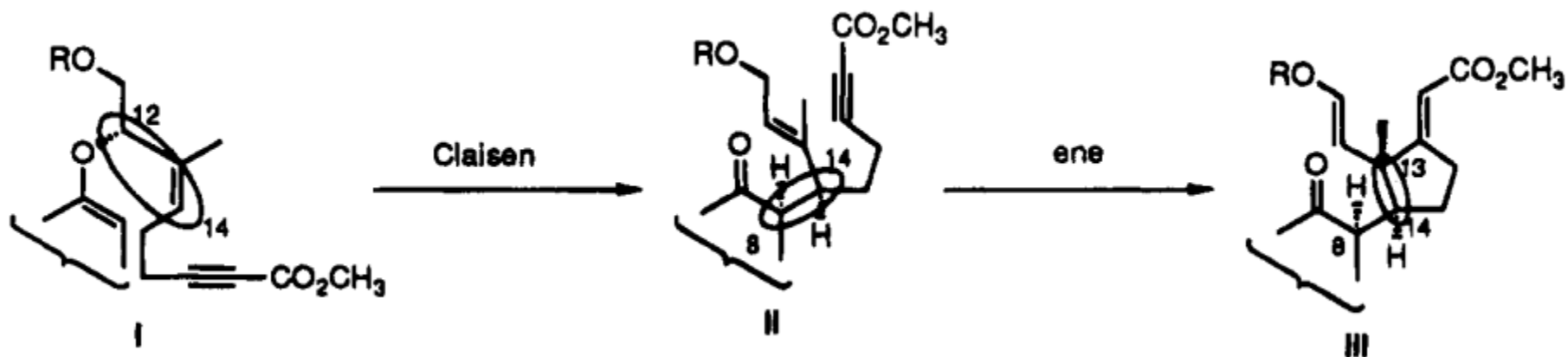
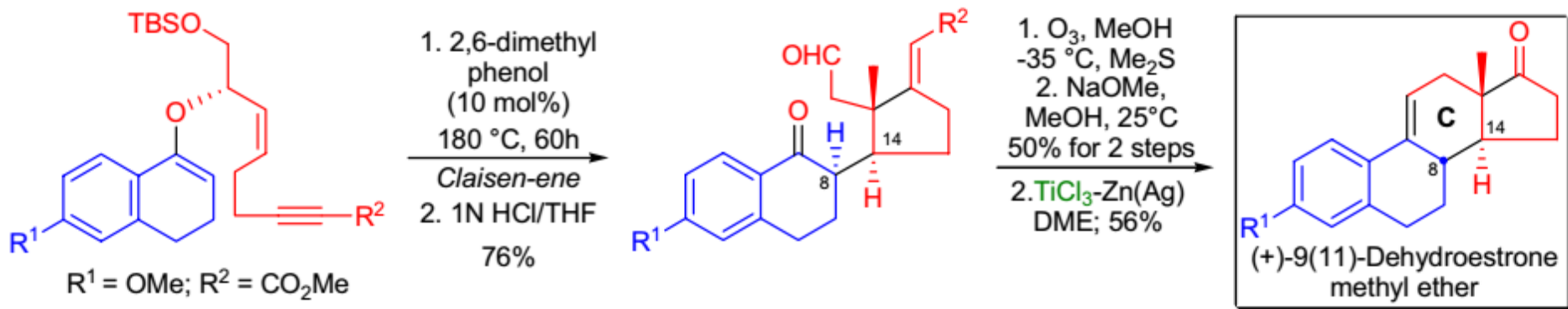


4. Applications of McMURRY COUPLING



To avoid any intermolecular coupling, high-dilution conditions were used. The cyclization precursor was added slowly via a syringe pump to a suspension of low-valent titanium reagent (TiCl₄/Zn) in refluxing DME. The reaction favored the formation of the (*E*)-olefin, the *E*/*Z* ratio was 2.5:1





Koichi Mikami; Kazuhiko Takahashi, Takeshi Nakai, et al.
 J. Am. Chem. SOC. 1994,116, 10948-10954