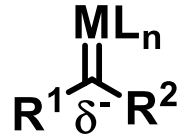
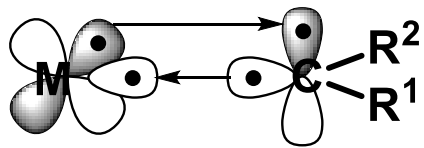


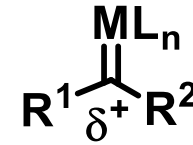
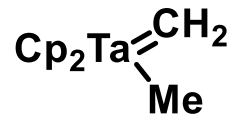
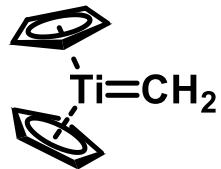
➤ Schrock carbene complexes



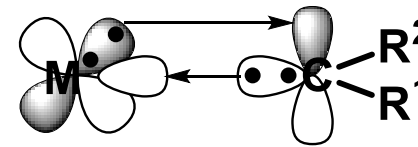
Schrock carbene complexes



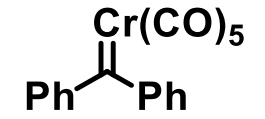
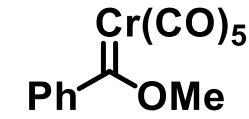
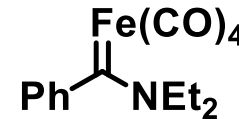
- High oxidation state metals (Ti, Ta)
- Non- π -electron acceptors ligands on metals
- Non- π -donor ligands on carbene ligand



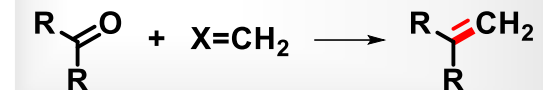
Fischer Carbene complexes



- Low oxidation state metals (Fe, Mo, Cr, W)
- π -electron acceptors ligands (CO) on metals
- π -donor ligands on carbene ligand (RO, R₂N, RS)

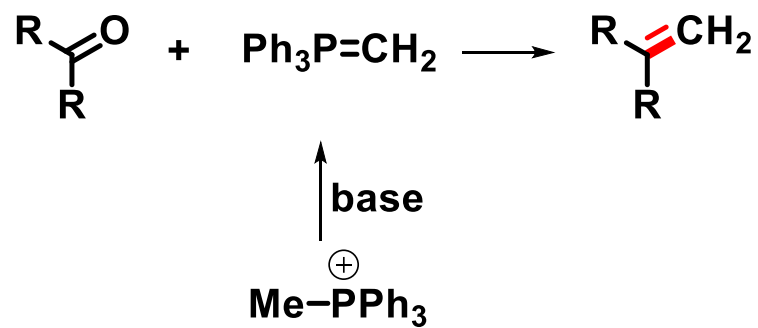


➤ Schrock carbene complexes

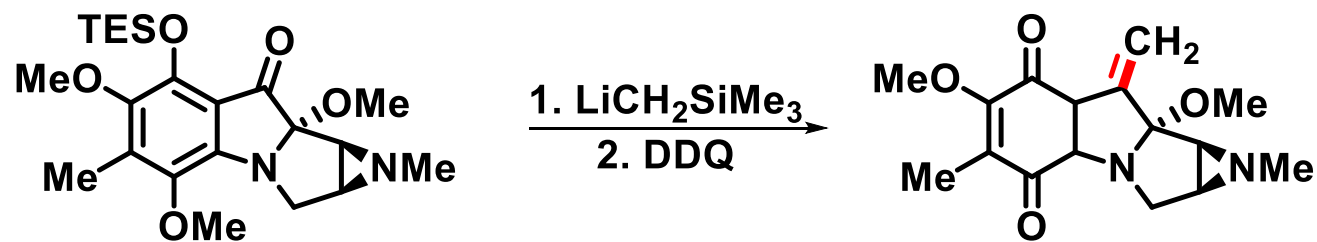


- Olefination
 - Traditional reagents for olefination

✓ Wittig olefination



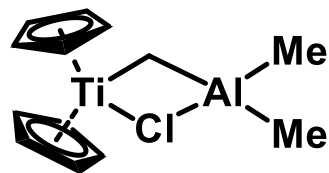
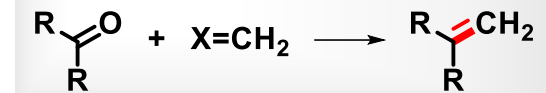
✓ Peterson olefination



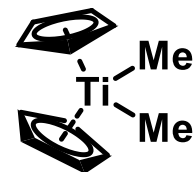
J. Org. Chem. **1988**, *53*, 3391

➤ Schrock carbene complexes

- Olefination
 - Titanium based reagents for olefination



Tebbe reagent

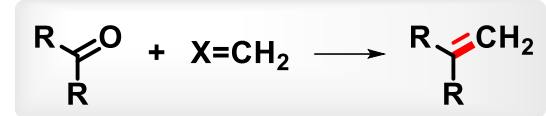


Petasis reagent

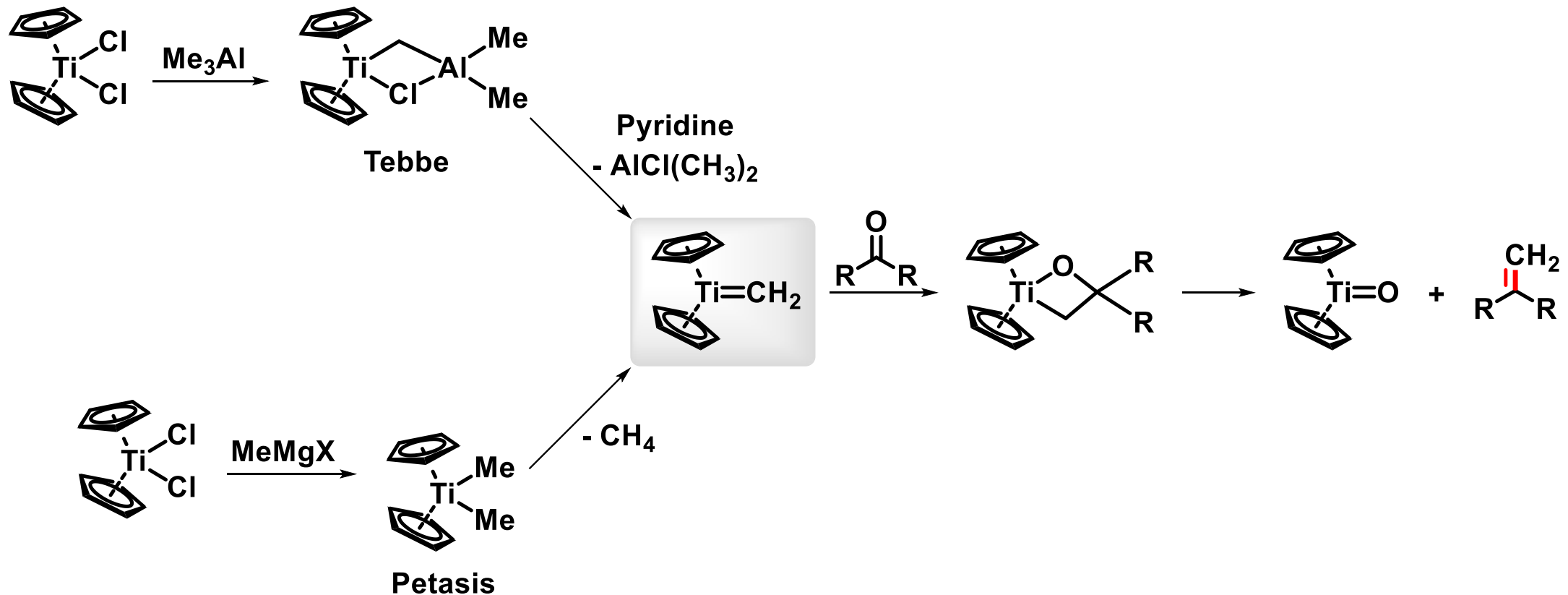
- ✓ Non-basic reagents
- ✓ Suitable for olefination of carboxylic acid derivatives

➤ Schrock carbene complexes

- Olefination
 - Titanium based reagents for olefination

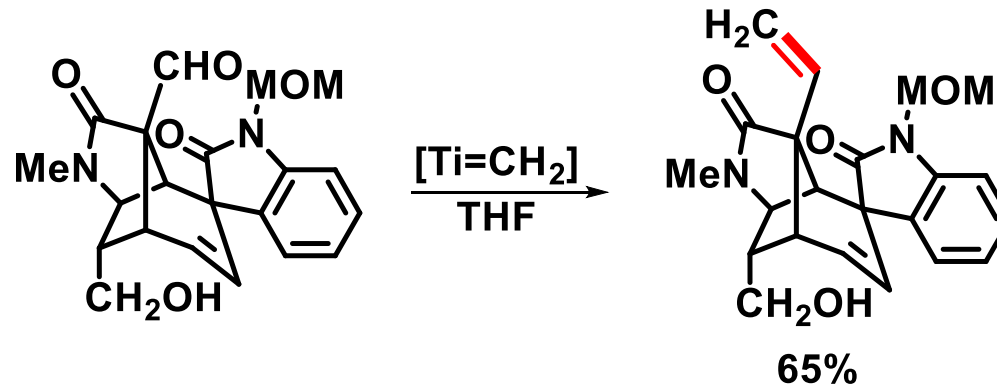
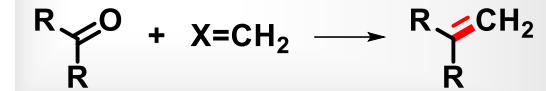


✓ Proposed mechanism



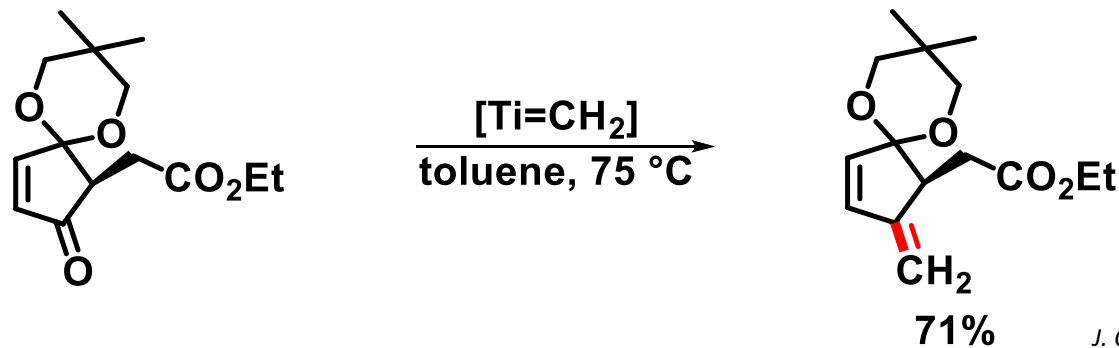
➤ Schrock carbene complexes

- Olefination
 - Titanium based reagents for olefination
 - ✓ Aldehydes



Pure Appl. Chem. **1997**, *69*, 501

- ✓ Ketones

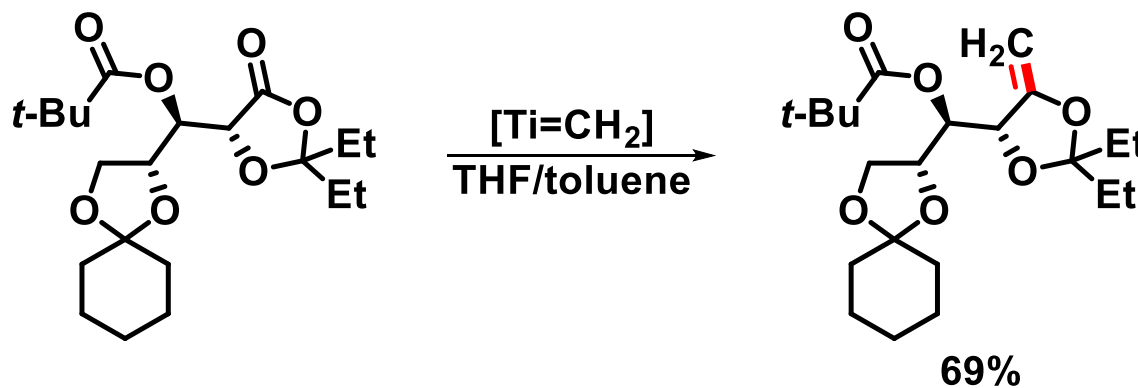


J. Chem. Soc., Perkin Trans I **1994**, 3525

➤ Schrock carbene complexes

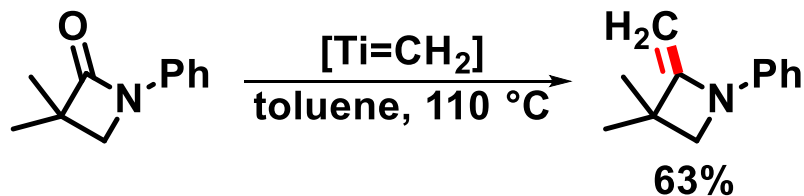
- Olefination
 - Titanium based reagents for olefination

✓ Esters

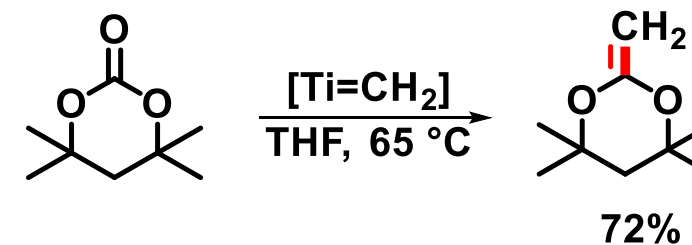


Tetrahedron Lett. 1994, 35, 2537

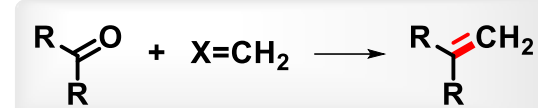
✓ Amides and carbonates



Tetrahedron Lett. 2000, 41, 1975



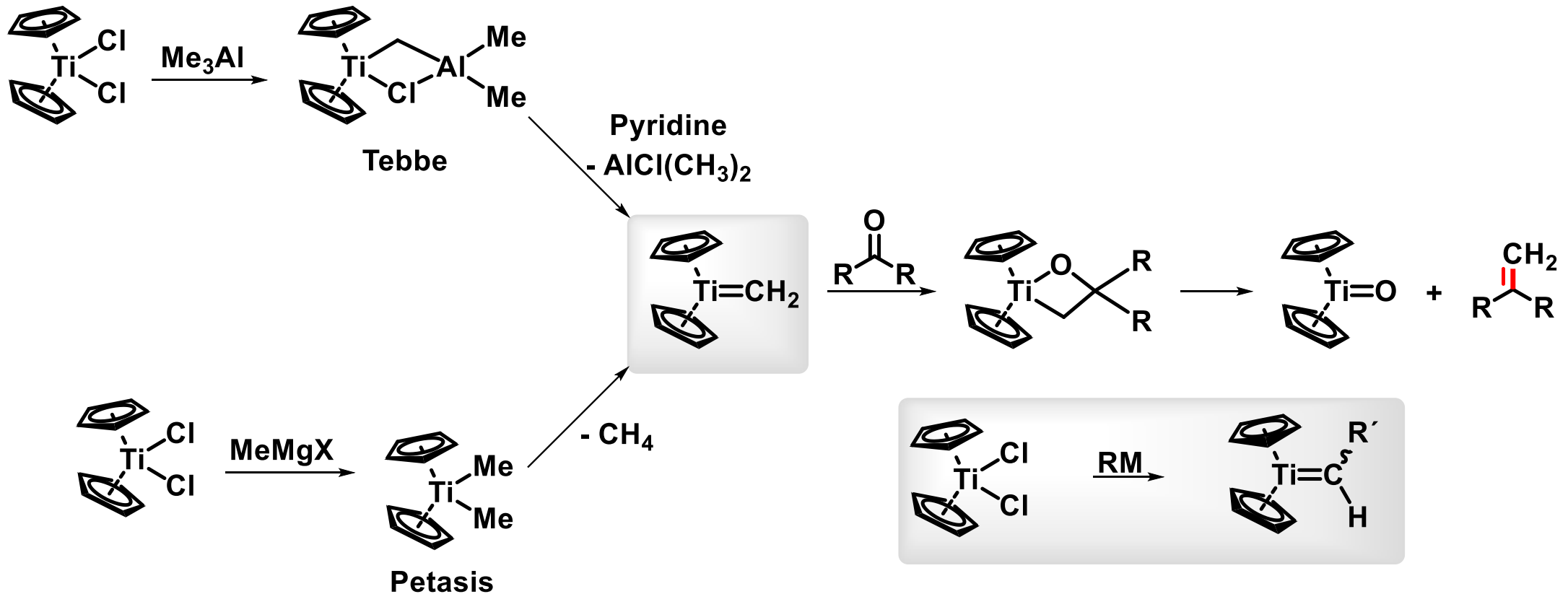
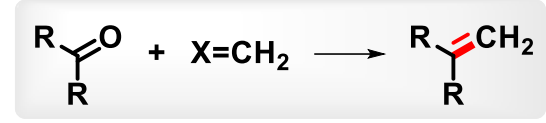
Tetrahedron Lett. 1995, 36, 2393



➤ Schrock carbene complexes

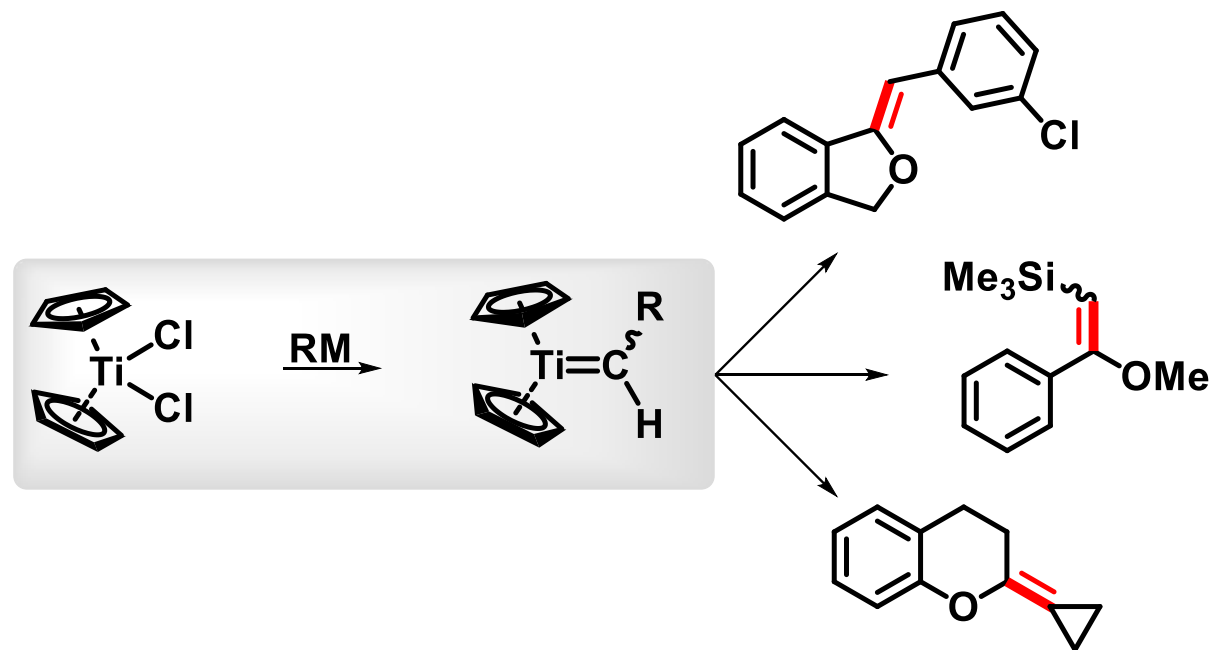
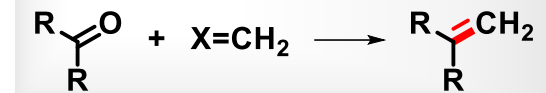
- Olefination

- Titanium based reagents for olefination – Advanced Petasis reagent



➤ Schrock carbene complexes

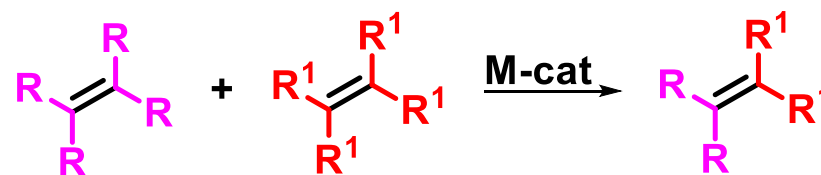
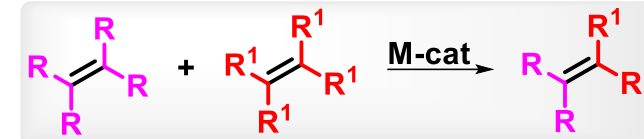
- Olefination
 - Titanium based reagents for olefination – Advanced Petasis reagent



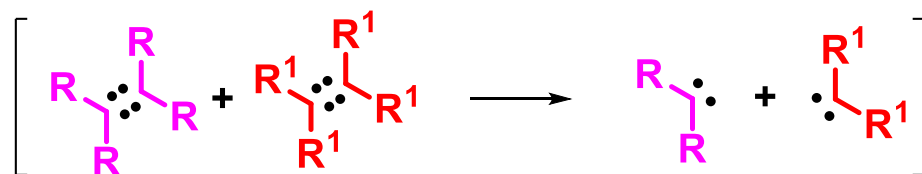
J. Chem. Soc., Perkin Trans. 1 **2002**, 2763

➤ Schrock carbene complexes

- Metathesis reactions – Alkene and Alkyne metathesis

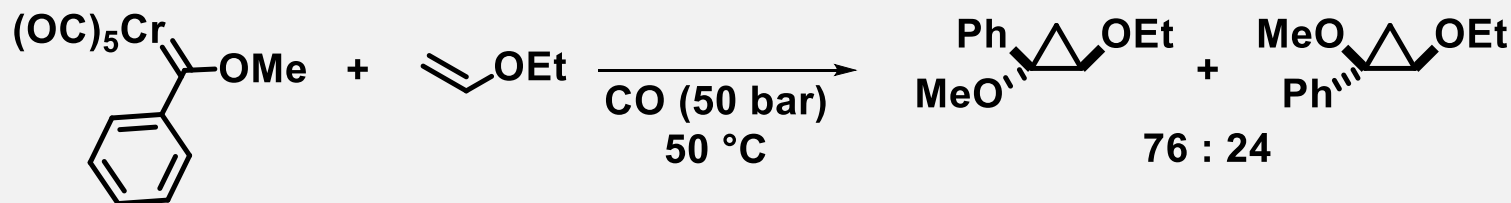
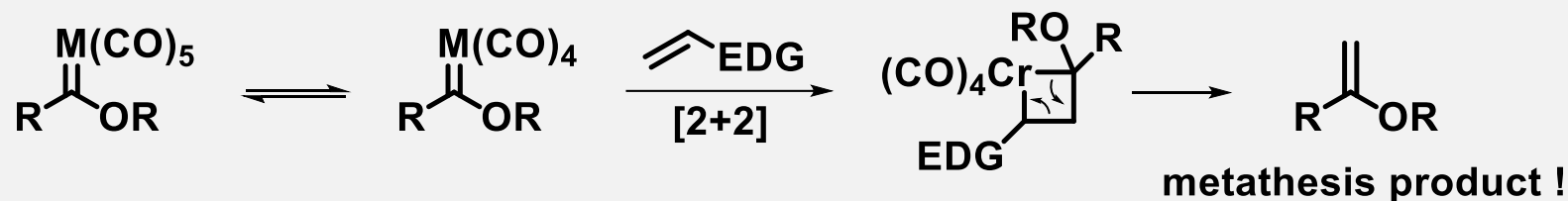


- The formalism of metathesis reactions



➤ Fischer carbene complexes

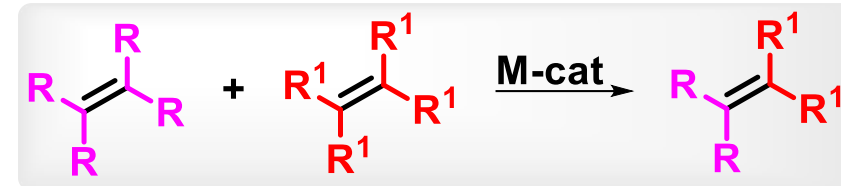
- Reactivity of Fischer carbene complexes ($\text{C}=\text{Cr}(\text{CO})_5 \cong \text{C}=\text{O}$)
- Reaction with alkenes – Cyclopropanations
 - ✓ Reaction with electron-rich alkenes



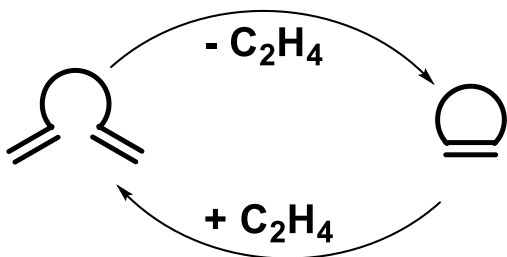
Chem. Rev. 1987, 87, 411

➤ Schrock carbene complexes

- Metathesis reactions – Alkene and Alkyne metathesis
 - Classes of olefin metathesis:

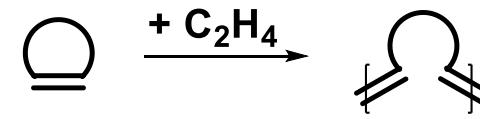


ring-closing metathesis (RCM)



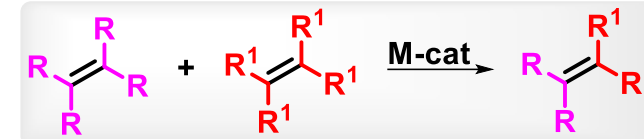
ring-opening metathesis (ROM)

ring-opening metathesis polymerisation (ROMP)

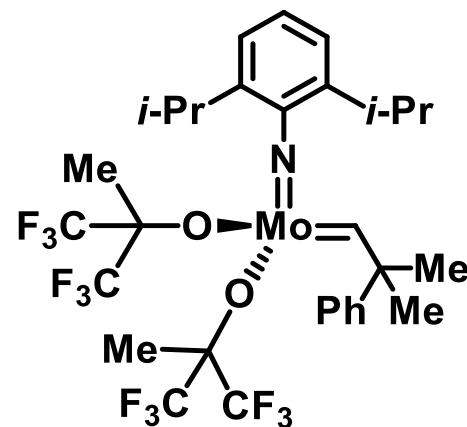
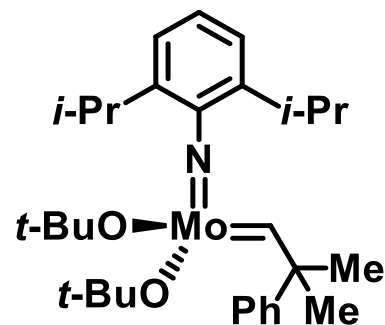


➤ Schrock carbene complexes

- Metathesis reactions – Alkene and Alkyne metathesis

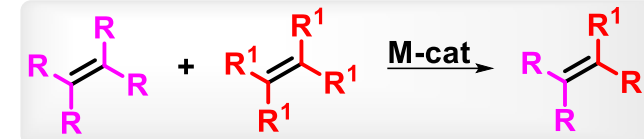


○ Schrock catalysts

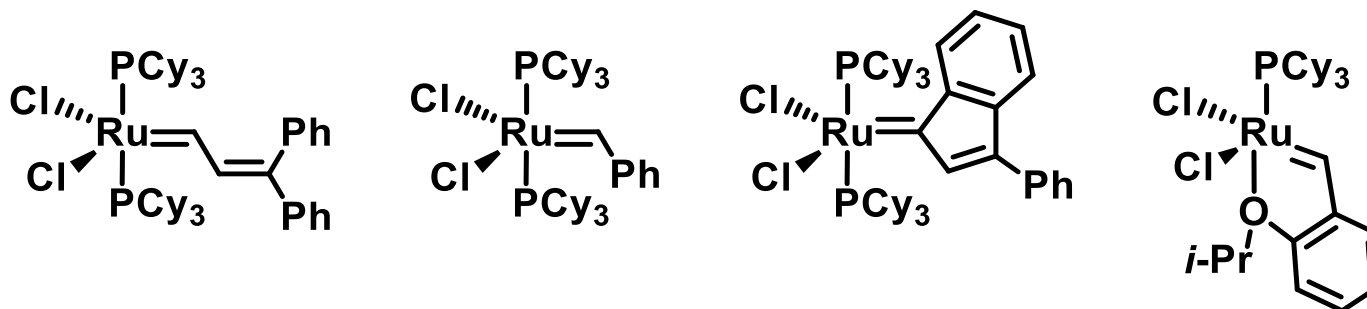


➤ Schrock carbene complexes

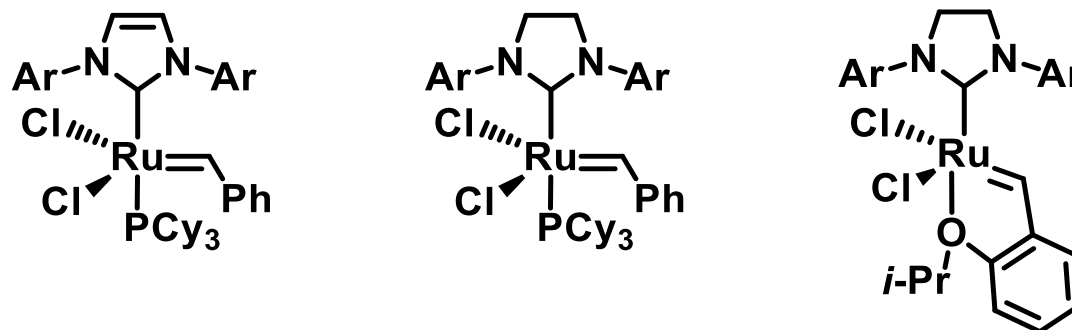
- Metathesis reactions – Alkene and Alkyne metathesis



- Grubbs catalysts with phosphine ligands

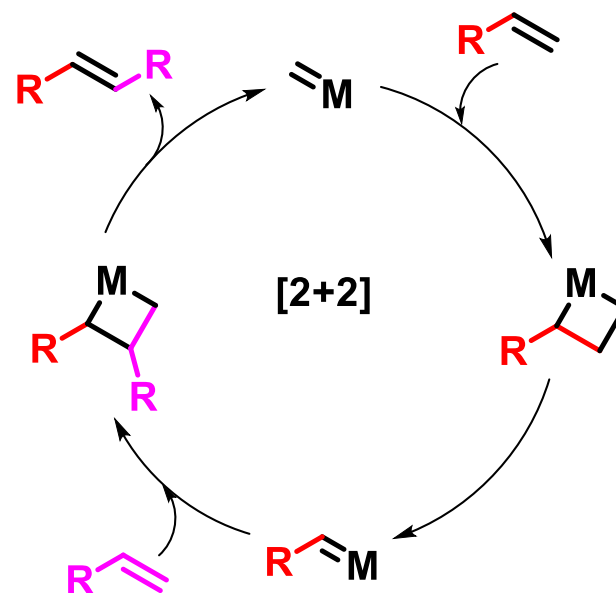


- Grubbs catalysts with NHC ligands



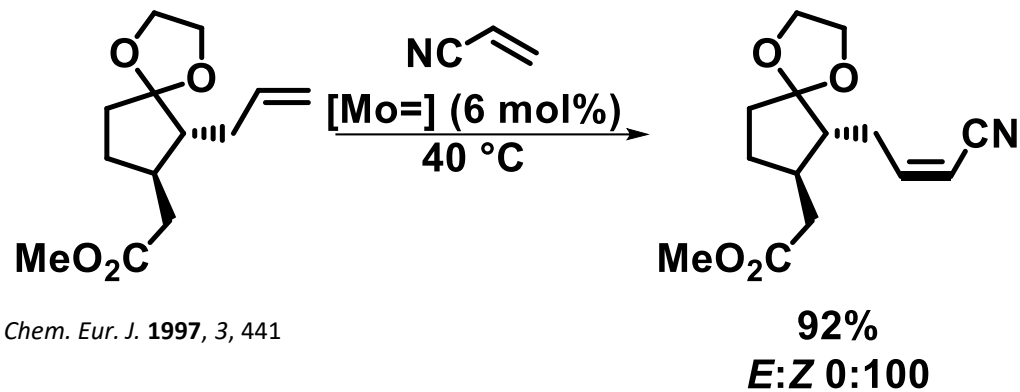
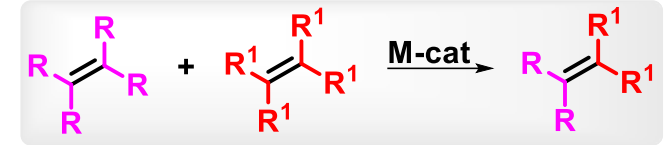
➤ Schrock carbene complexes

- Metathesis reactions – Alkene and Alkyne metathesis
 - Mechanism of metathesis reactions

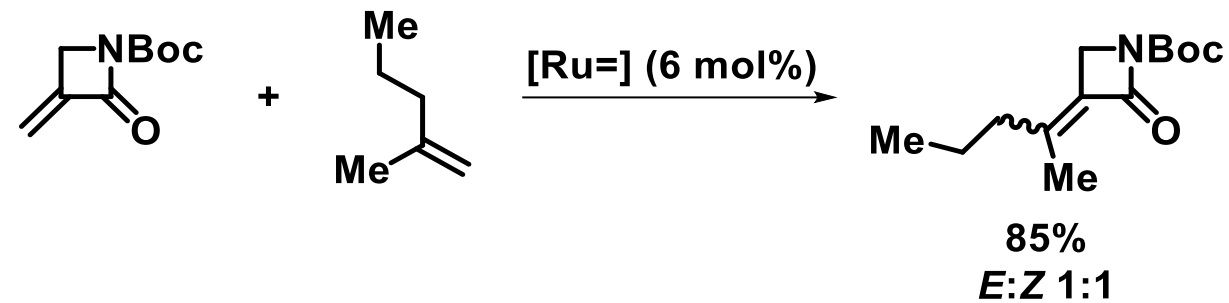


➤ Schrock carbene complexes

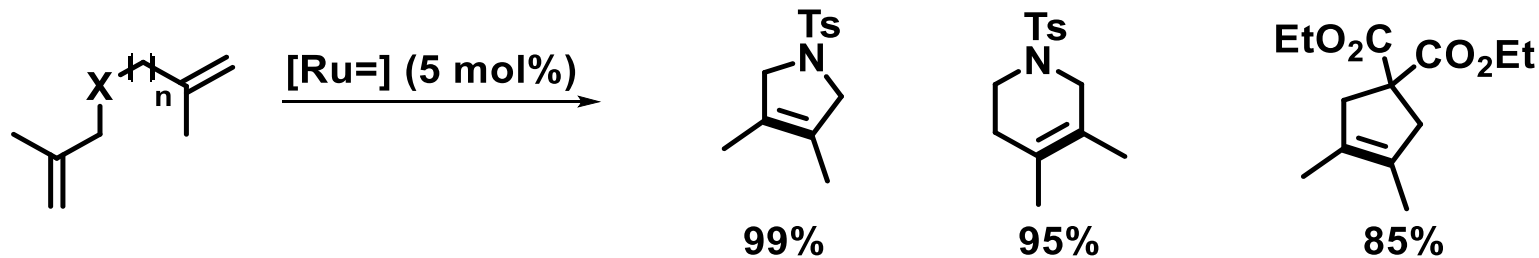
- Metathesis reactions – Alkene and Alkyne metathesis
 - Cross metathesis, RCM – Selected examples



Chem. Eur. J. 1997, 3, 441



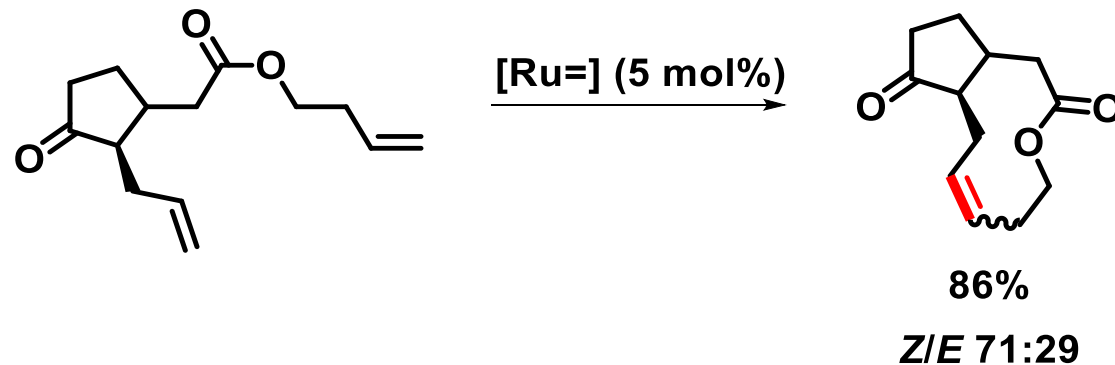
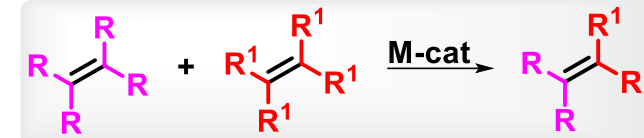
Tetrahedron Lett. 2009, 50, 1020



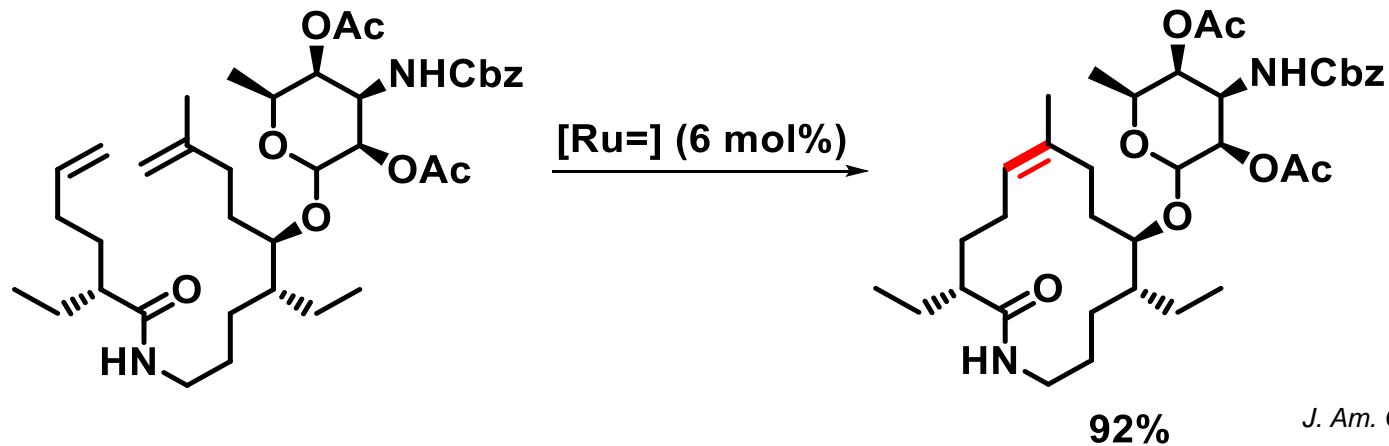
Chem. Eur. J. 2007, 13, 8029

➤ Schrock carbene complexes

- Metathesis reactions – Alkene and Alkyne metathesis
 - Cross metathesis, RCM – Selected examples



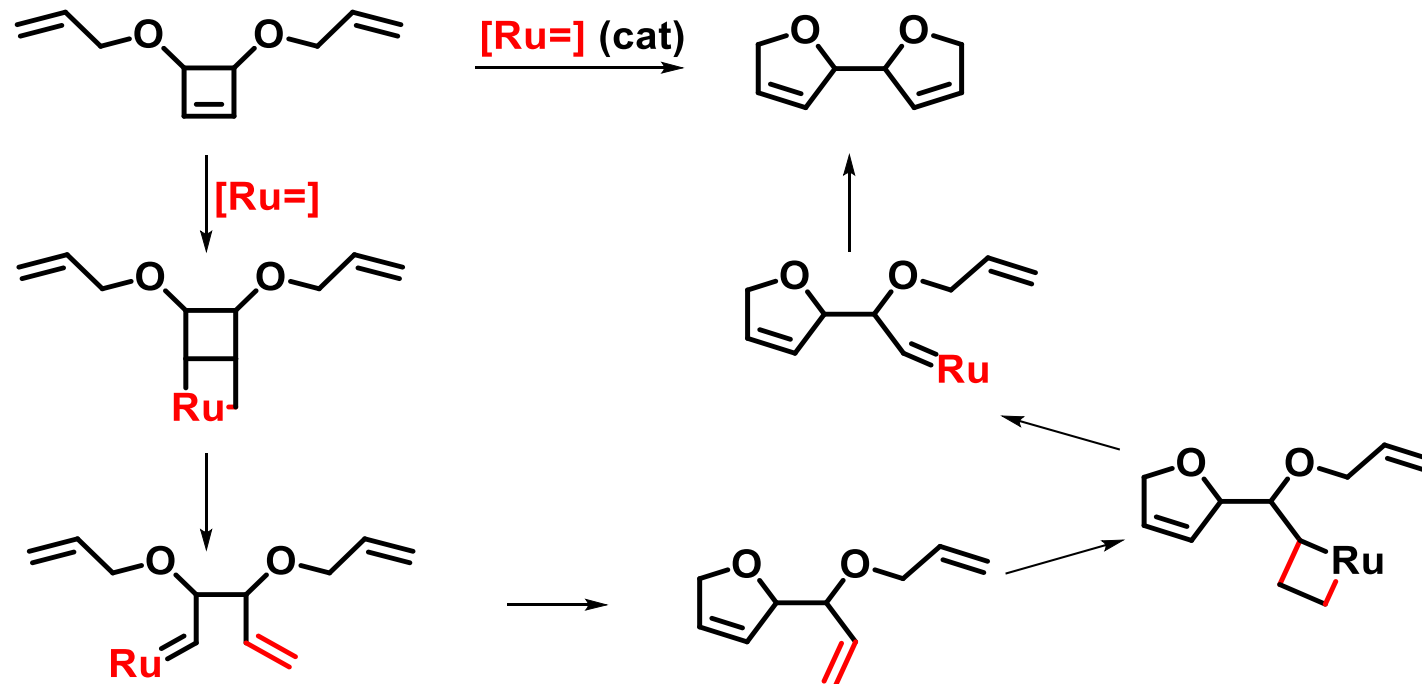
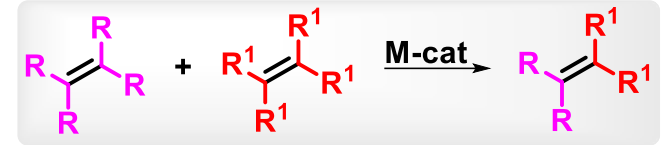
Synlett **1997**, 1010



J. Am. Chem. Soc. **1997**, 119, 10302

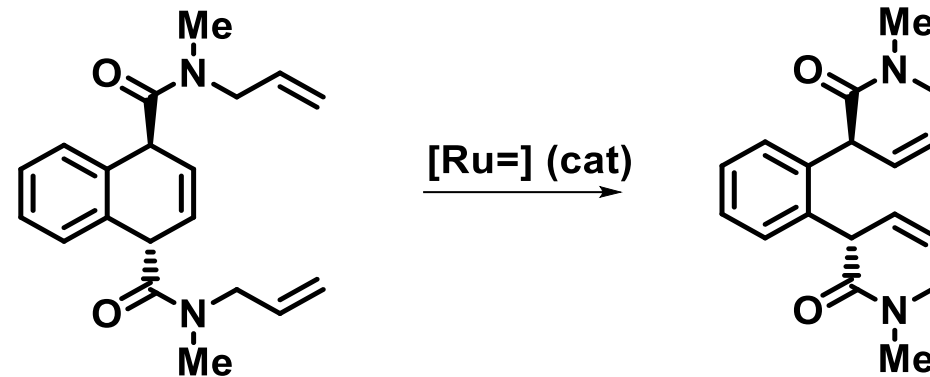
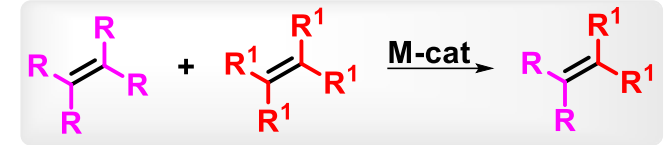
➤ Schrock carbene complexes

- Metathesis reactions – Alkene and Alkyne metathesis
 - Ring-opening-closing metathesis (ROCM)



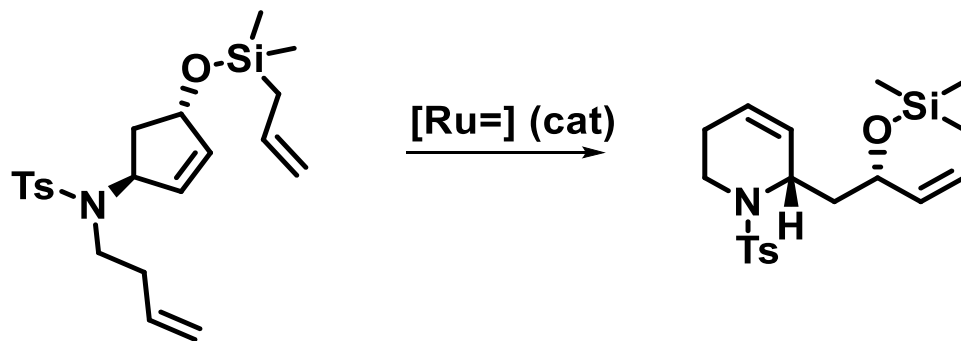
➤ Schrock carbene complexes

- Metathesis reactions – Alkene and Alkyne metathesis
 - Ring-opening-closing metathesis (ROCM)



95%

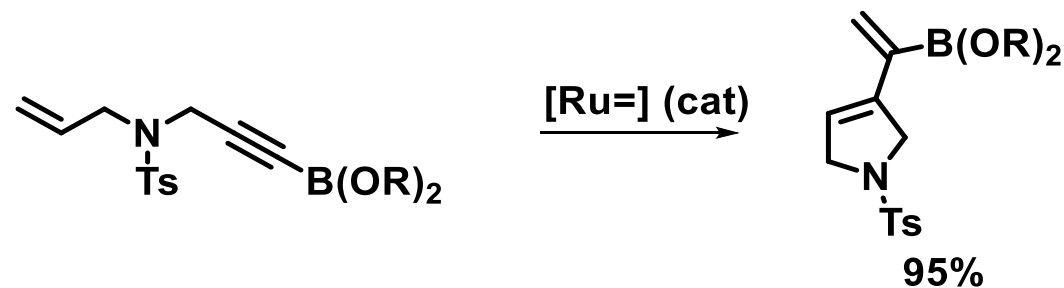
J. Am. Chem. Soc. 1996, 118, 6634



Tetrahedron, 1999, 55, 8179

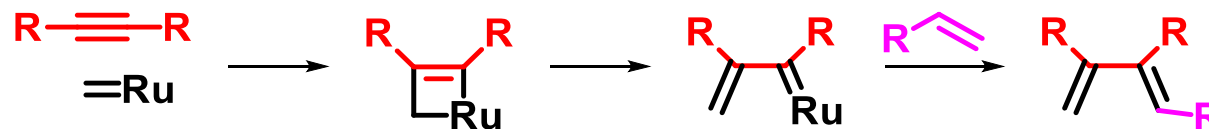
➤ Schrock carbene complexes

- Metathesis reactions – Alkene and Alkyne metathesis
 - Enynes metathesis – Selected example and mechanism



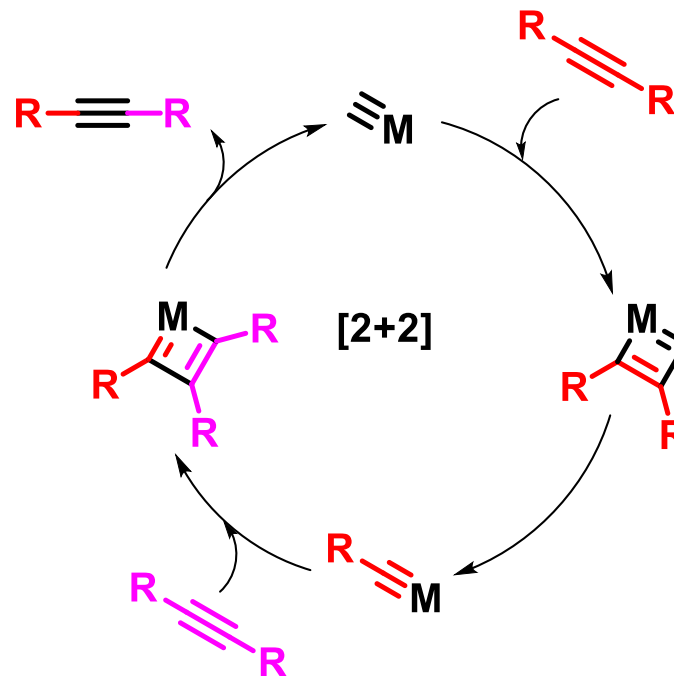
Angew. Chem. Int. Ed. **2000**, 39, 3101

✓ Selected intermediates



➤ Schrock carbene complexes

- Metathesis reactions – Alkene and Alkyne metathesis
 - Alkyne metathesis

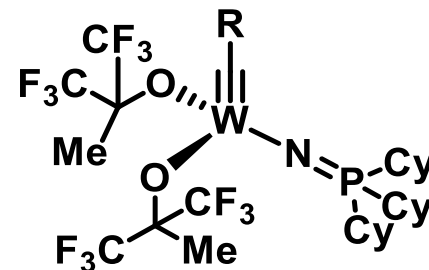
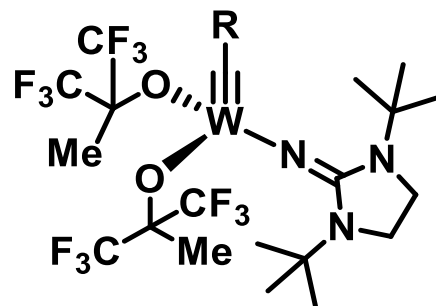


➤ Schrock carbene complexes

- Metathesis reactions – Alkene and Alkyne metathesis

- Alkyne metathesis

✓ Selected Schrock catalysts



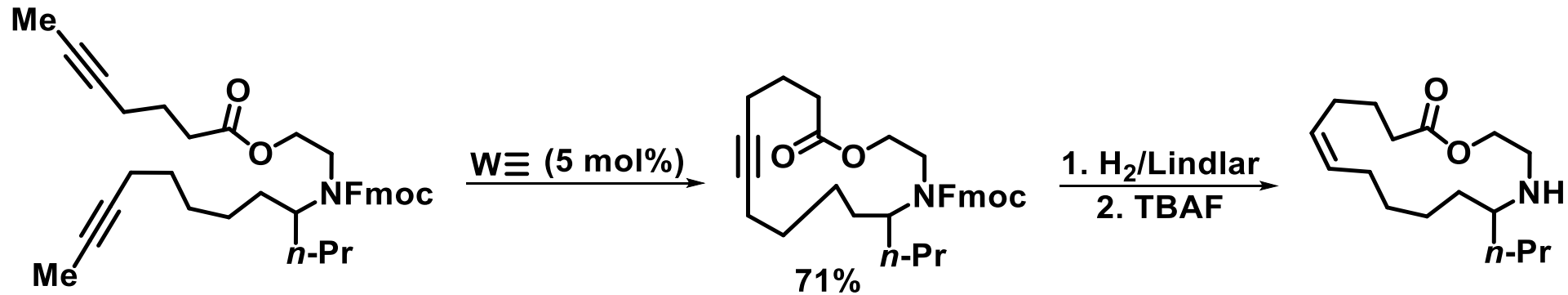
➤ Schrock carbene complexes



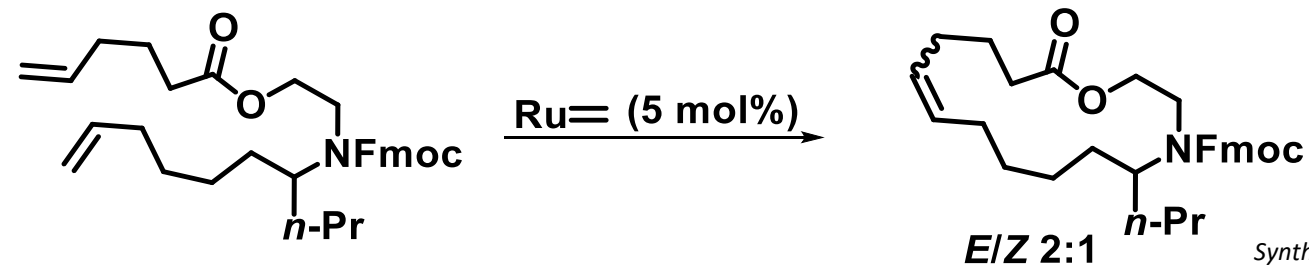
- Metathesis reactions – Alkene and Alkyne metathesis

- Alkyne metathesis

✓ Stereoselective synthesis of Z-alkenes by alkyne metathesis–hydrogenation sequence



J. Am. Chem. Soc. **1999**, *121*, 11108



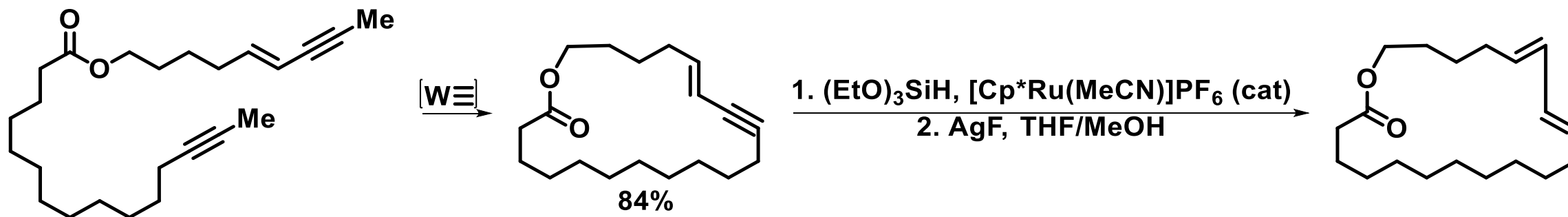
Synthesis **1997**, 792

➤ Schrock carbene complexes

- Metathesis reactions – Alkene and Alkyne metathesis

- Alkyne metathesis

✓ Stereoselective synthesis of *E*-alkenes by alkyne metathesis–*trans*-hydrosilylation



Tetrahedron, 2004, 60, 7315