# ORGANIC CHEMISTRY 2 LECTURE GUIDE 2019

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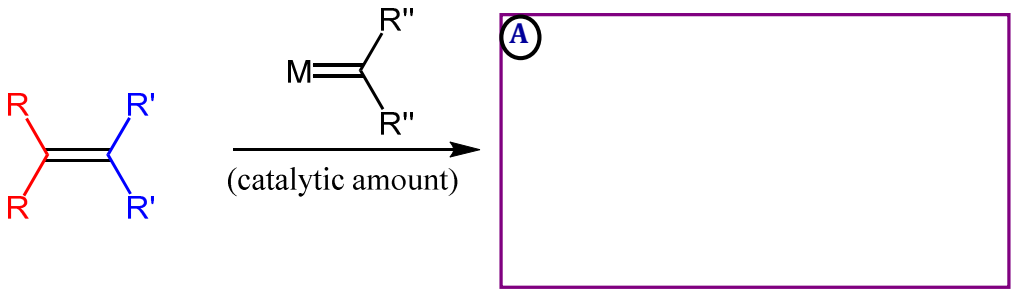
## Lesson V.5. Introduction to Alkene Metathesis

*Schrock*

Prof. Richard Schrock (now at MIT) worked with early transition metals and noted that some metals having a C=M bond could cause "scrambling" of alkenes:



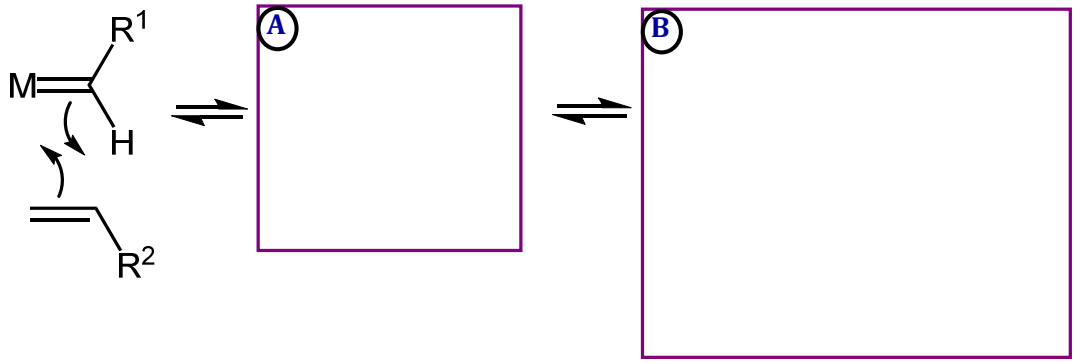

This reaction involves *breaking* the C=C double bond and *rearranging* the two doubly-bound units! This is a process called **alkene metathesis**. This reaction has become so important that three of the pioneers of the field won the Nobel Prize in Chemistry for this work.

*Notes*

## Lesson V.5. Introduction to Alkene Metathesis

*Chauvin*

Yves Chauvin did some work to elucidate the mechanism my which a simpler metathesis reaction takes place:



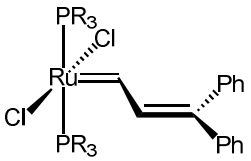

The major product is generally the more stable of the possible alkenes.

*Notes*

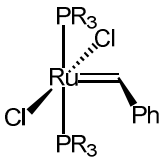
## Lesson V.5. Introduction to Alkene Metathesis

*Grubbs*

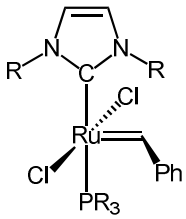
Robert Grubbs developed catalysts that are stable in the air (this is a big improvement over many of the air-sensitive organometallic reagents we have talked about). These catalysts use ruthenium (Ru) as the metal:




**first ruthenium alkylidene catalyst**




**first-generation Grubbs catalyst**




**second-generation Grubbs catalyst**

Key features:

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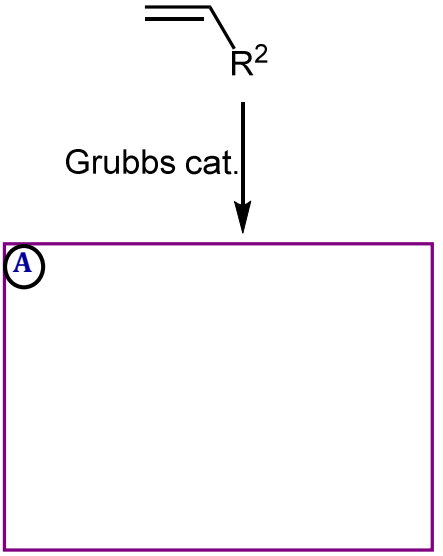
## Lesson V.6. Applications of Alkene Metathesis

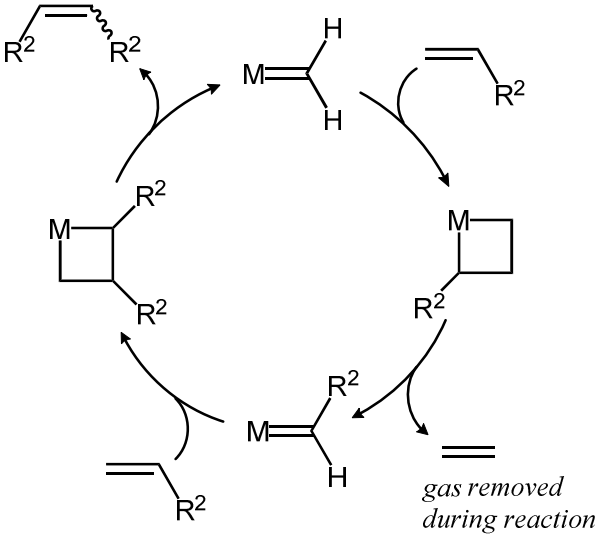
*Ethenolysis*

The Grubbs catalysts can be used to mediate many useful reactions, including Cross metathesis. This reaction is driven to one major product by removal of ethylene gas (ethenolysis).

### Example:




### Catalytic Cycle:

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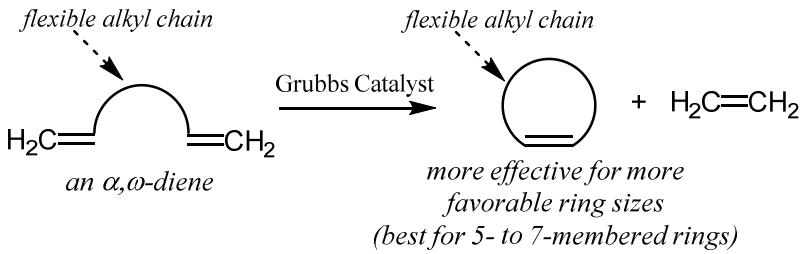
## Lesson V.6. Applications of Alkene Metathesis

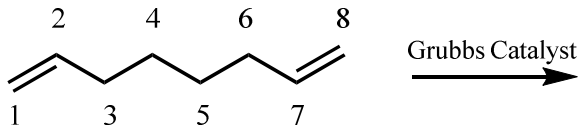
*Ring-closing metathesis (RCM)*

For favorable ring sizes (5- to 7-carbons), Grubbs catalyst can be used for Ring-Closing Metathesis (RCM):

**General:**




**Specific Example:**

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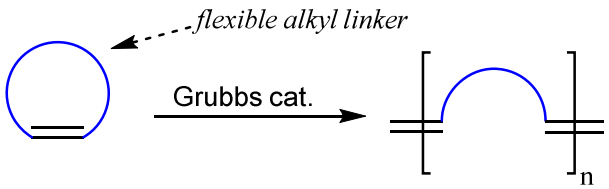
## *Notes*

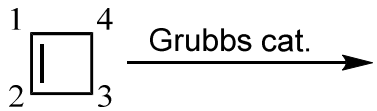
## Lesson V.6. Applications of Alkene Metathesis
*Ring-opening metathesis polymerization (ROMP)*

On the other hand, *strained rings* can undergo **Ring-Opening Metathesis Polymerization (ROMP)** with Grubbs catalyst:

**General:**




**Specific Examples:**

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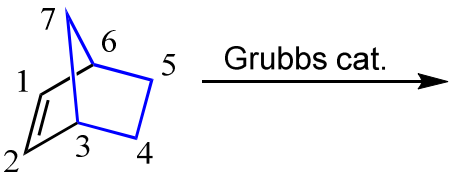


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