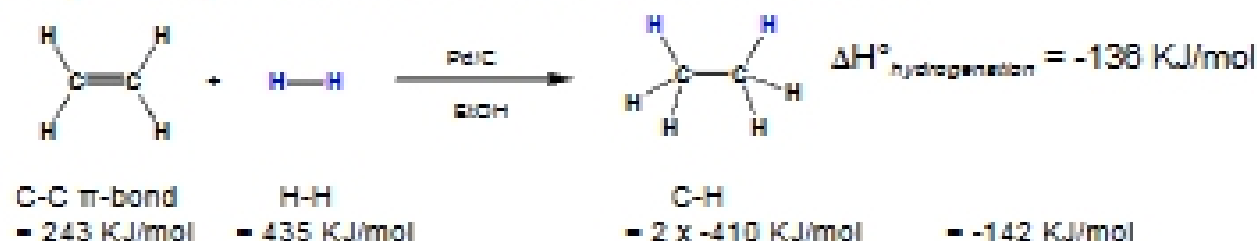


## Chapter 6: Reactions of Alkenes: Addition Reactions

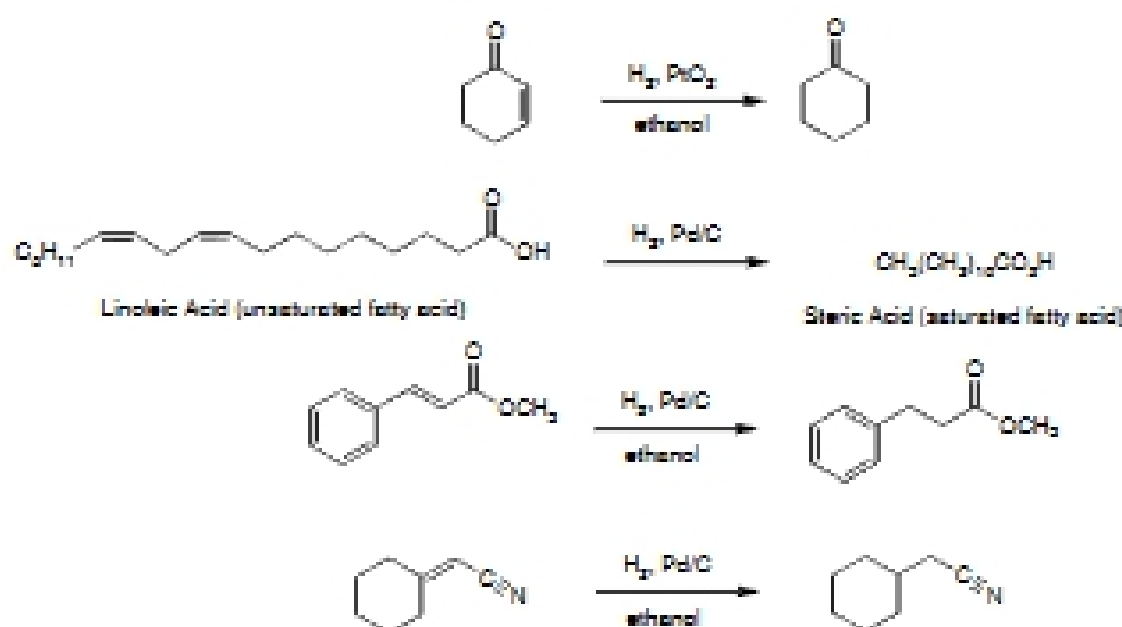
**6.1: Hydrogenation of Alkenes** – addition of H-H ( $H_2$ ) to the  $\pi$ -bond of alkenes to afford an alkane. The reaction must be catalyzed by metals such as Pd, Pt, Rh, and Ni.



- The catalyst is not soluble in the reaction media, thus this process is referred to as a *heterogeneous* catalysis.
- The catalyst assists in breaking the  $\pi$ -bond of the alkene and the H-H  $\sigma$ -bond.
- The reaction takes place on the surface of the catalyst. Thus, the rate of the reaction is proportional to the surface area of the catalyst.

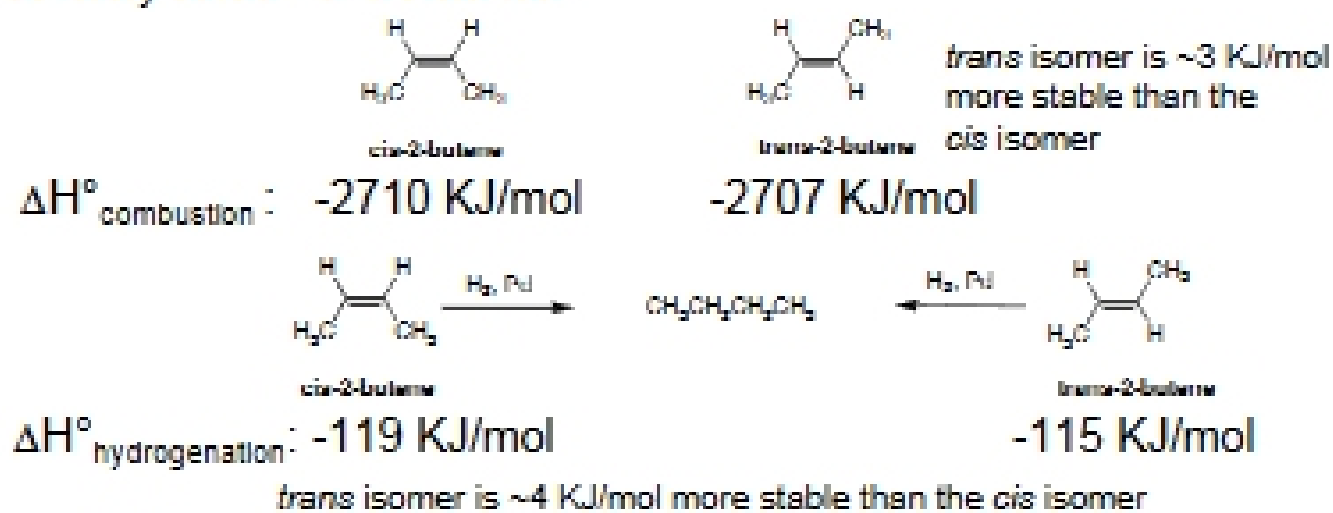
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- Carbon-carbon  $\pi$ -bond of alkenes and alkynes can be reduced to the corresponding saturated C-C bond. Other  $\pi$ -bond bonds such as C=O (carbonyl) and C $\equiv$ N are not easily reduced by catalytic hydrogenation. The C=C bonds of aryl rings are *not* easily reduced.

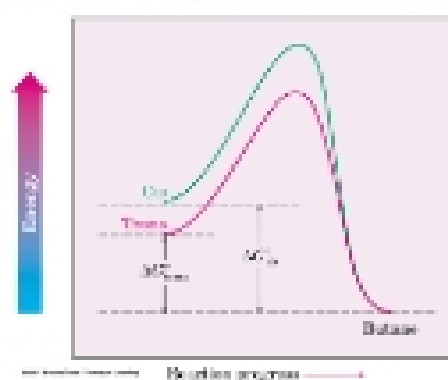


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## 6.2: Heats of Hydrogenation - can be used to measure relative stability of isomeric alkenes











The greater release of heat, the less stable the reactant.



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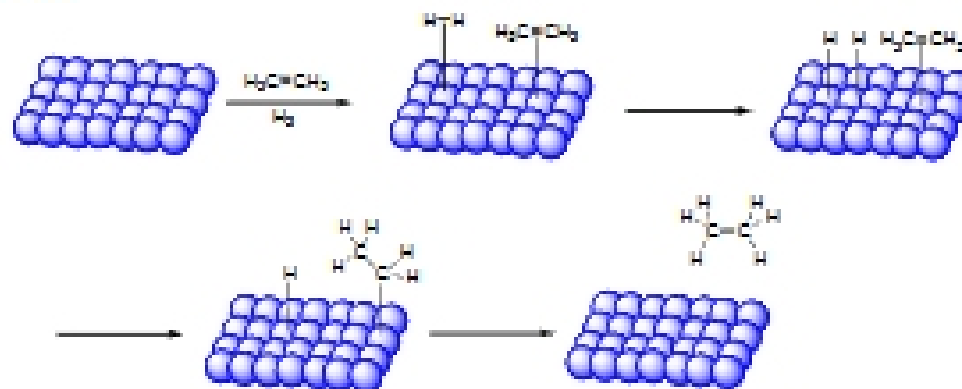
Table 6.1 (pg 228): Heats of Hydrogenation of Some Alkenes

	Alkene	$\Delta H^\circ$ (KJ/mol)
		136
monosubstituted		125 - 126
		117 - 119
disubstituted		114 - 115
		116 - 117
		112
trisubstituted		110
tetrasubstituted		110

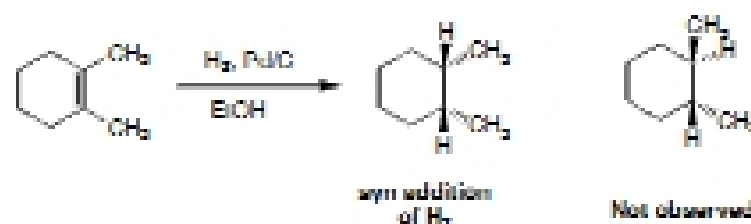
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### 6.3: Stereochemistry of Alkene Hydrogenation

Mechanism:

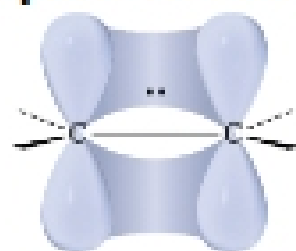


The addition of  $H_2$  across the  $\pi$ -bond is *syn*, *i.e.*, from the same face of the double bond



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### 6.4: Electrophilic Addition of Hydrogen Halides to Alkenes



Carbon-carbon  $\sigma$  bond:  
weaker: more accessible electrons

C-C  $\sigma$ -bond:  $\Delta H^\circ = 368 \text{ KJ/mol}$

C-C  $\pi$ -bond:  $\Delta H^\circ = 243 \text{ KJ/mol}$

$\pi$ -bond of an alkene can  
act as a nucleophile!!

Electrophilic addition reaction



Bonds broken

C=C  $\pi$ -bond 243 KJ/mol

H-Br 366 KJ/mol

Bonds formed

$H_3C-H_2C-H$  -410 KJ/mol

$H_3C-H_2C-Br$  -283 KJ/mol

calc.  $\Delta H^\circ = -84 \text{ KJ/mol}$

expt.  $\Delta H^\circ = -84 \text{ KJ/mol}$

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