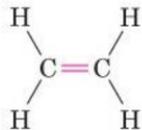
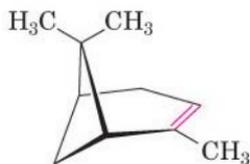


# Alcheni



**Etilene**



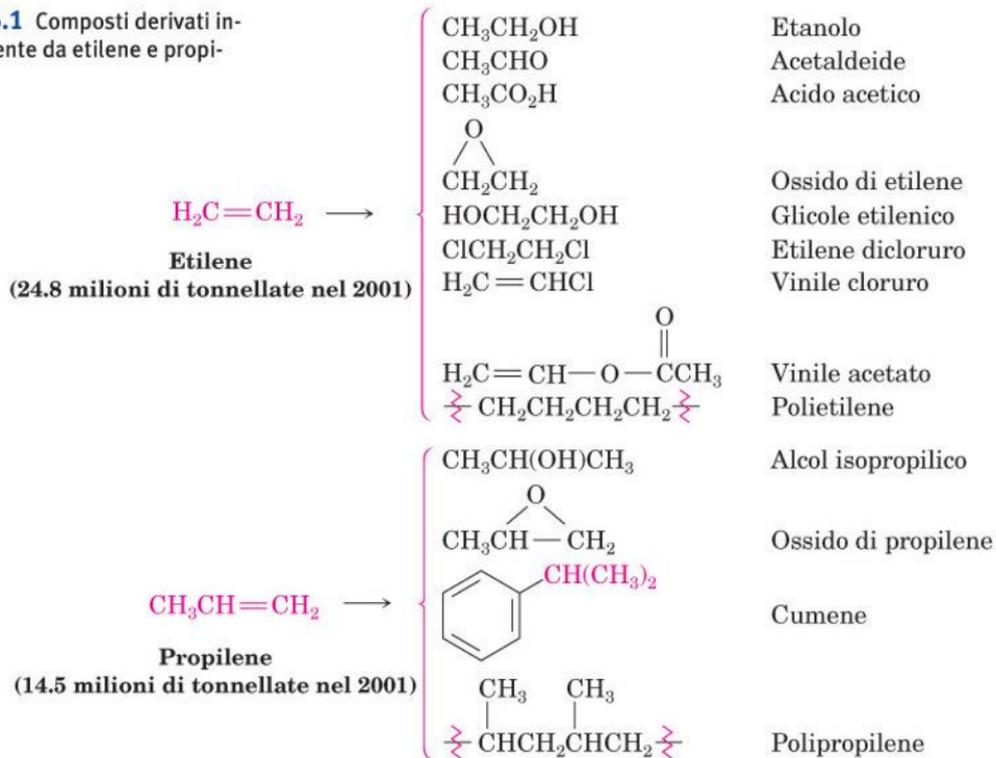
**$\alpha$ -Pinene**

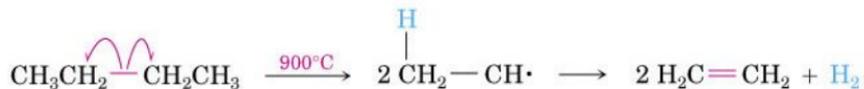
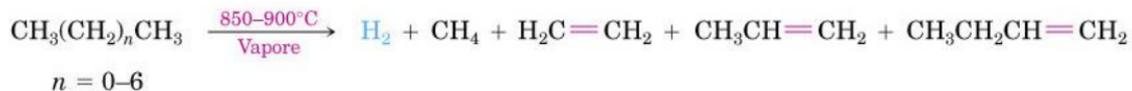


**$\beta$ -Carotene**

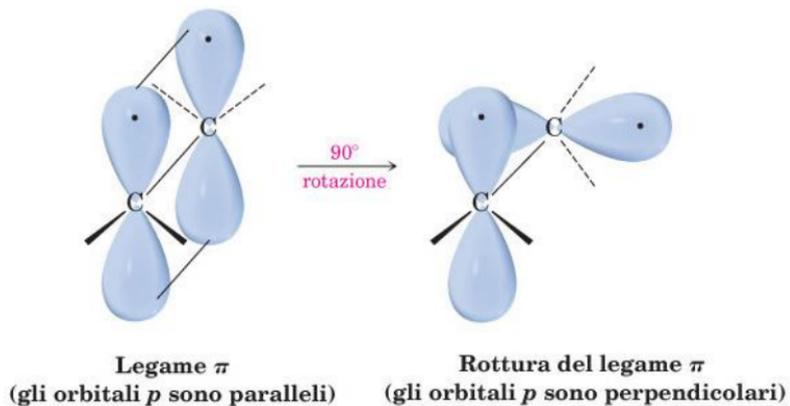
**(pigmento arancione e precursore della vitamina A)**

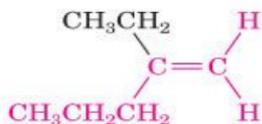
**FIGURA 6.1** Composti derivati industrialmente da etilene e propilene.



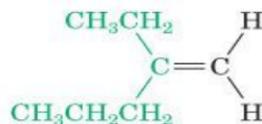


**FIGURA 6.2** Il legame  $\pi$  deve rompersi perché possa avvenire una rotazione attorno al doppio legame carbonio-carbonio.





Denominato come un *pentene* **NON**



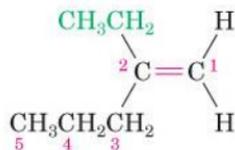
come un esene, perché il doppio legame è contenuto nella catena a sei atomi di carbonio



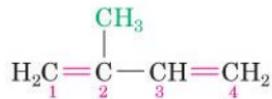
**2-Esene**



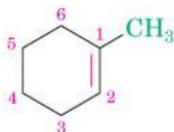
**2-Metil-3-esene**



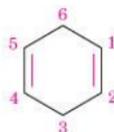
**2-Etil-1-pentene**



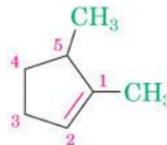
**2-Metil-1,3-butadiene**



**1-Metilcicloesene**



**1,4-Cicloesadiene**



**1,5-Dimetilciclopentene**



**Gruppo metilenico**

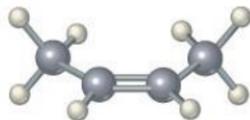
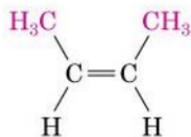


**Gruppo vinilico**

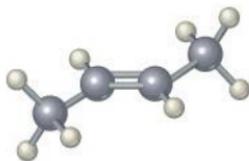
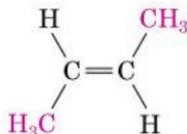


**Gruppo alilico**

**FIGURE 6.3** Isomeri cis e trans del 2-butene. L'isomero cis ha i due gruppi metilici dalla stessa parte del doppio legame, mentre l'isomero trans ha i gruppi metilici da parti opposte.

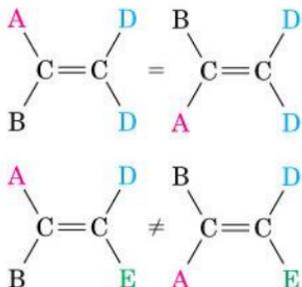


*cis*-2-Butene



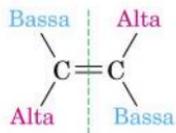
*trans*-2-Butene

**FIGURA 6.4** Requisito per l'isomeria cis-trans negli alcheni. I composti che hanno uno dei loro atomi di carbonio legato a due gruppi identici non possono esistere come isomeri cis-trans. Solo quelli che presentano entrambi gli atomi di carbonio legati a due gruppi differenti possono esistere come isomeri cis-trans.

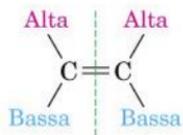


Questi due composti sono identici;  
non si tratta di isomeri cis-trans.

Questi due composti non sono identici;  
si tratta di isomeri cis-trans.



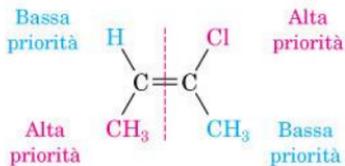
Doppio legame *E*  
(I gruppi a priorità più alta  
si trovano su lati **opposti**.)



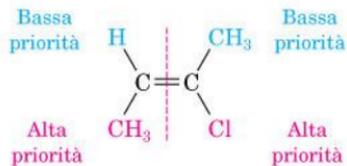
Doppio legame *Z*  
(I gruppi a priorità più alta  
si trovano sullo **stesso** lato.)



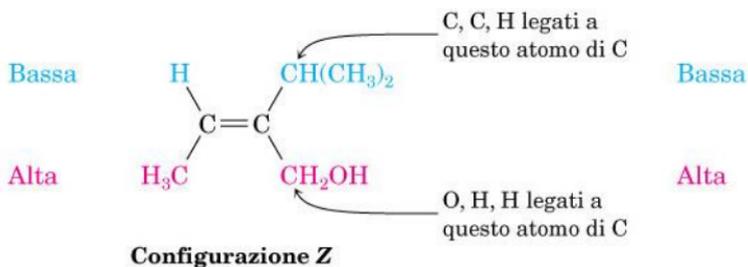
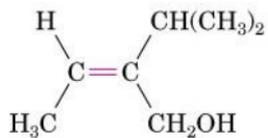
Per esempio:

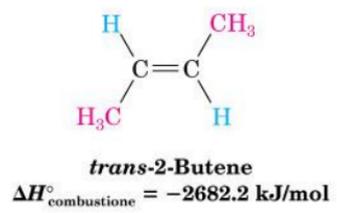
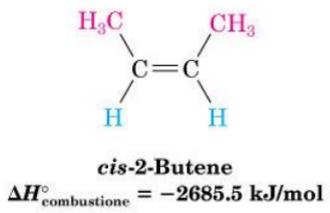
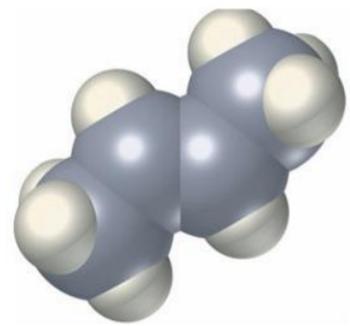
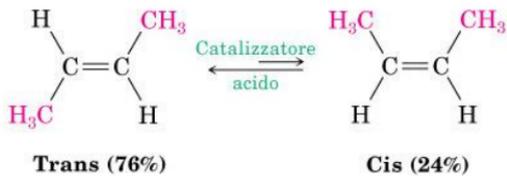


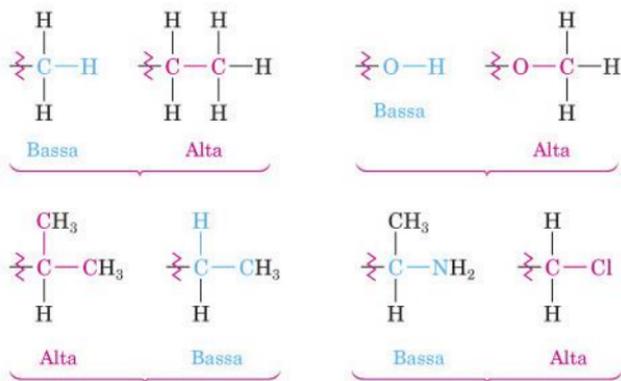
(a) *(E)*-2-Cloro-2-butene

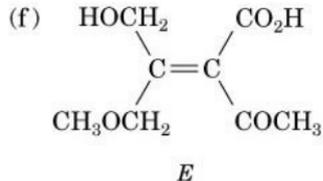
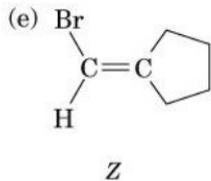
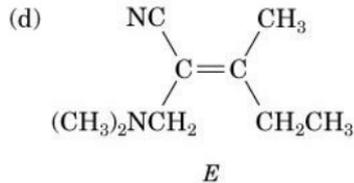
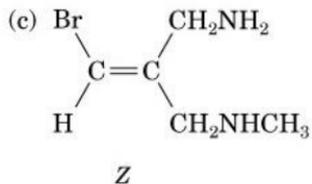
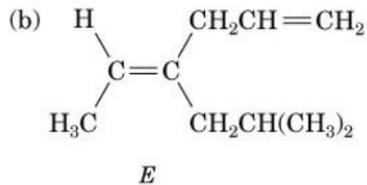
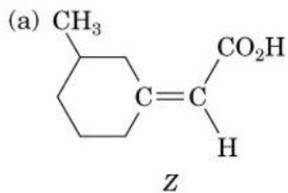


(b) *(Z)*-2-Cloro-2-butene





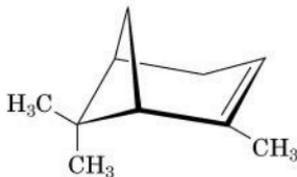




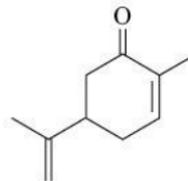
# Isoprene e terpeni



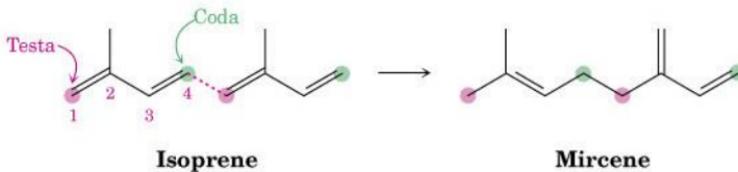
**Mircene**  
(olio di alloro)

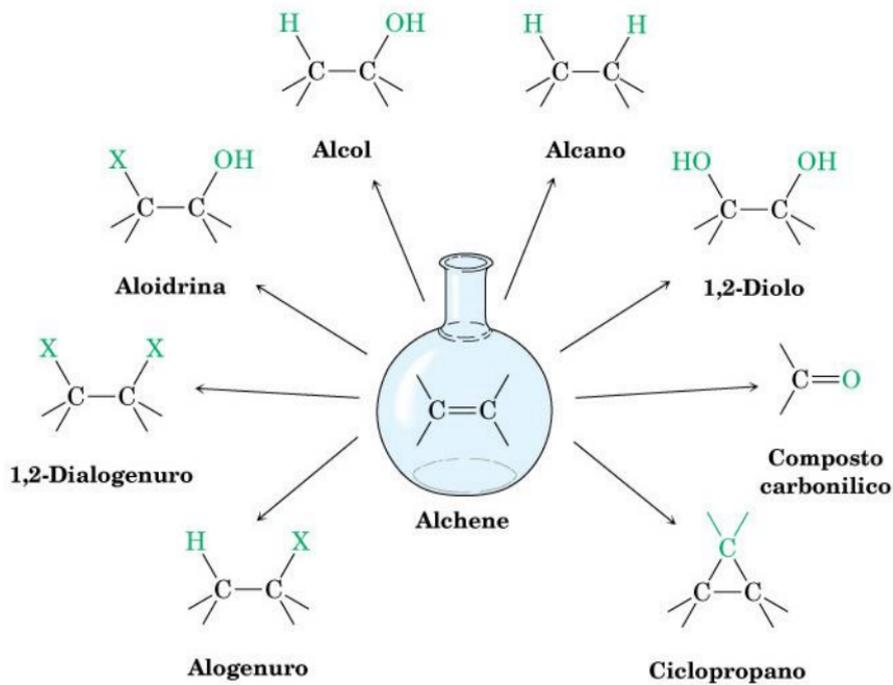


**α-Pinene**  
(trementina)

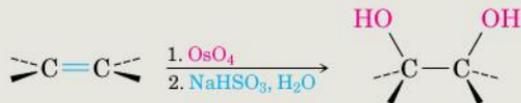
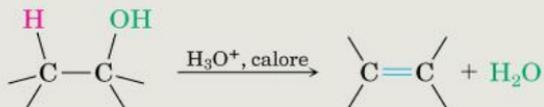


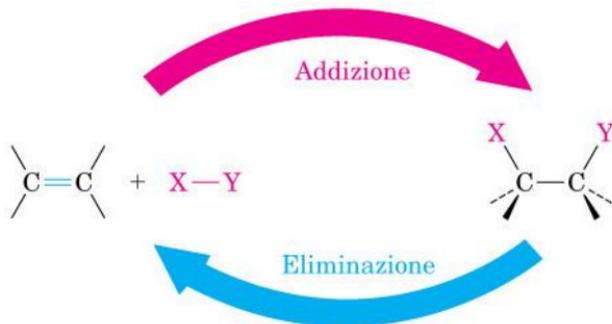
**Carvone**  
(olio di menta piperita)





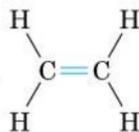
# Reattività alcheni



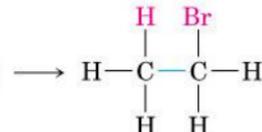


# Addizione

Questi due reagenti ...

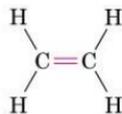
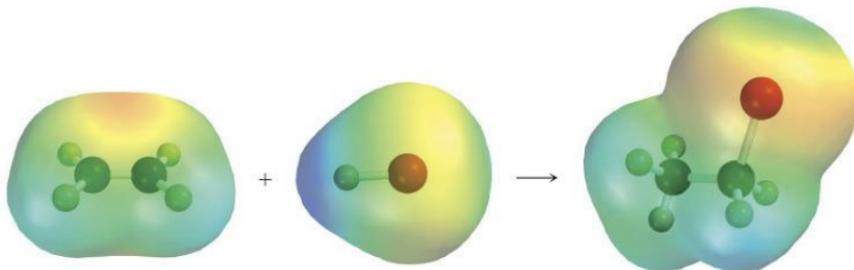


**Etilene**  
(alchene)

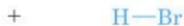


**Bromoetano**  
(alogenuro alchilico)

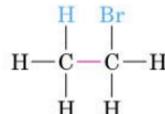
... si aggiungono per dare questo prodotto.



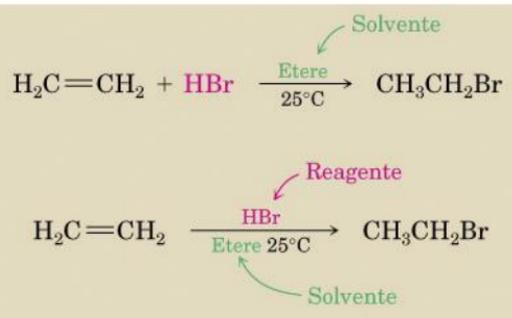
**Etilene**  
(nucleofilo)



**Bromuro di idrogeno**  
(elettrofilo)

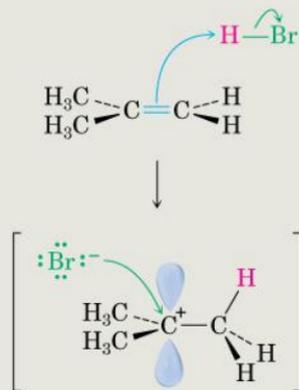


**Bromoetano**



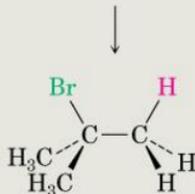
**FIGURA 6.7 MECCANISMO:** Addizione elettrofila di HBr al 2-metilpropene. La reazione avviene in due stadi e comporta la formazione di un carbocatione intermedio.

L'elettrofilo HBr viene attaccato dagli elettroni  $\pi$  del doppio legame, con conseguente formazione di un nuovo legame  $\sigma$  C—H. Questo lascia l'altro atomo di carbonio con una carica + ed un orbitale  $p$  vacante.

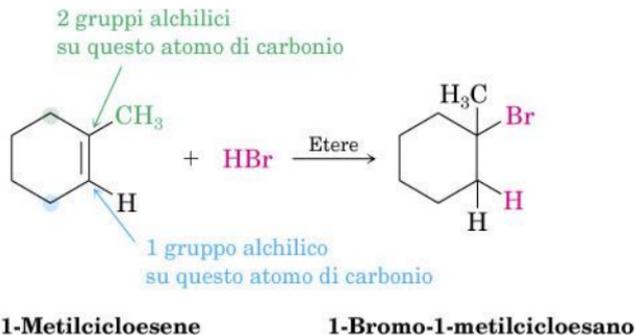
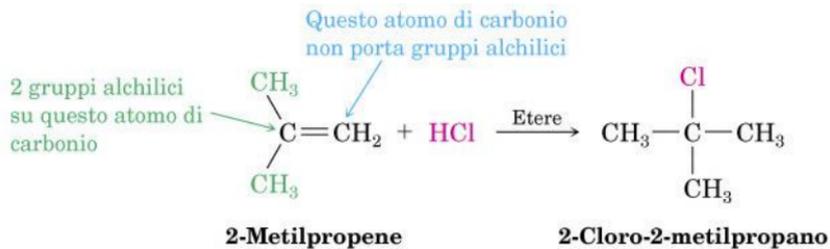


**Intermedio  
carbocationico**

Lo ione  $\text{Br}^-$  dona una coppia di elettroni all'atomo di carbonio carico positivamente, formando un legame  $\sigma$  C—Br e fornendo il prodotto neutro di addizione.

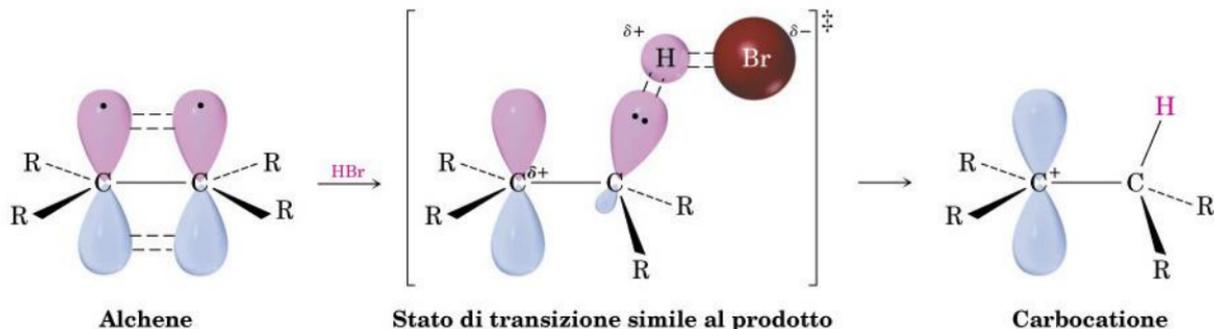


© 1994 John McMurry



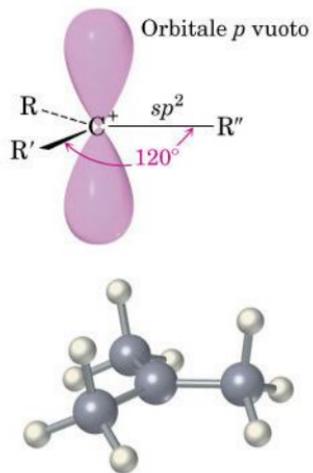
**FIGURA 6.14**

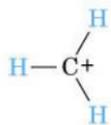
Struttura ipotetica di uno stato di transizione per la protonazione di un alchene. Lo stato di transizione è più simile sia per energia che per struttura al carbocatione piuttosto che all'alchene. Perciò un incremento della stabilità del carbocatione (più basso  $\Delta G^\circ$ ) provoca anche un incremento di stabilità dello stato di transizione (più basso  $\Delta G^\ddagger$ )



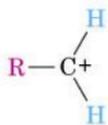


**FIGURA 6.9** Struttura elettronica di un carbocatione. L'atomo di carbonio trivalente è ibridizzato  $sp^2$  e possiede un orbitale  $p$  vuoto che si estende perpendicolarmente al piano definito dall'atomo di carbonio e dai gruppi legati ad esso.

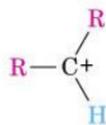




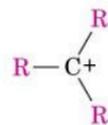
**Metilico**



**Primario (1°)**



**Secondario (2°)**

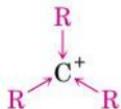


**Terziario (3°)**

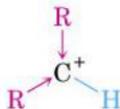
**Meno stabile**

Stabilità

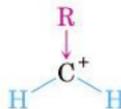
**Più stabile**



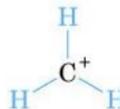
**3°: Tre gruppi alchilici  
che donano elettroni**



**2°: Due gruppi alchilici  
che donano elettroni**



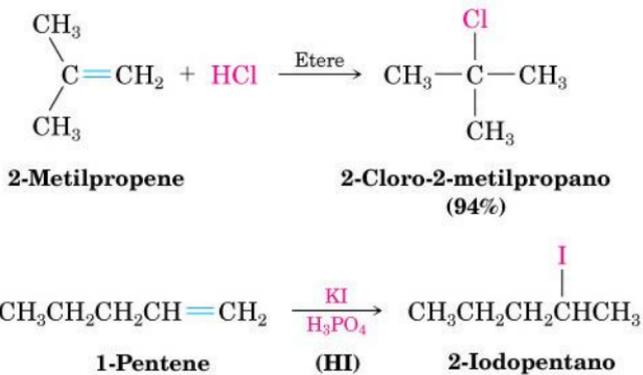
**1°: Un gruppo alchilico  
che dona elettroni**

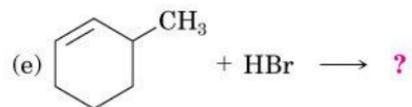
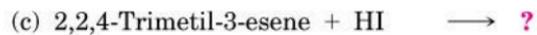
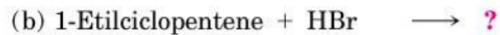
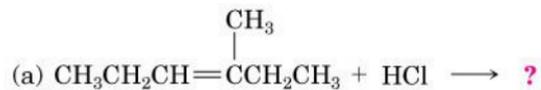


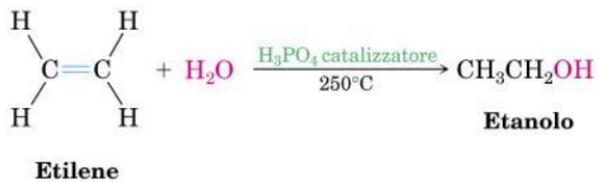
**Metilico: nessun gruppo  
alchilico che dona elettroni**

Terziario (3°) > Secondario (2°) > Primario (1°) > Metilico

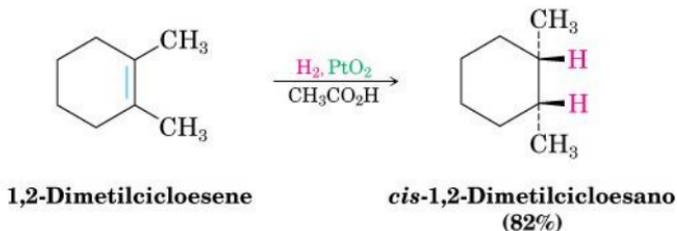
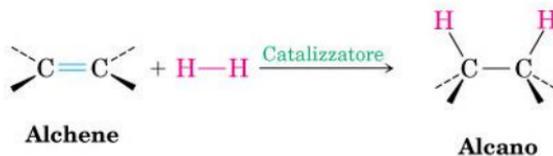


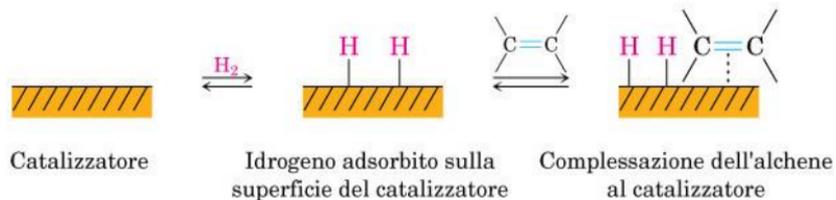




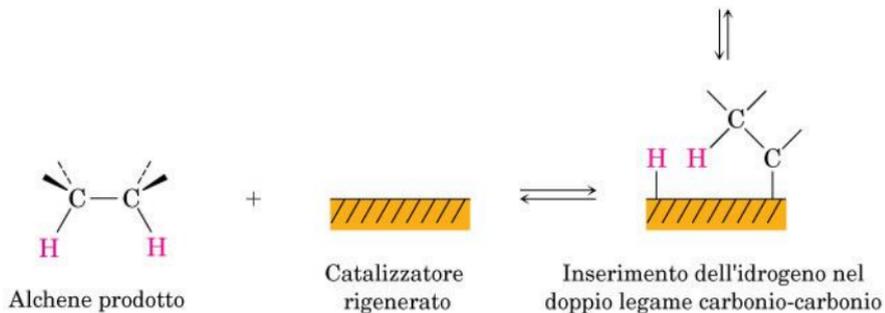


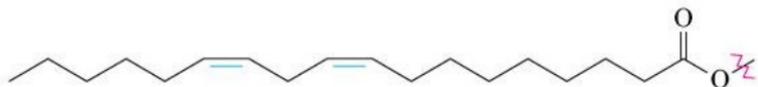
# Idrogenazione/riduzione catalitica



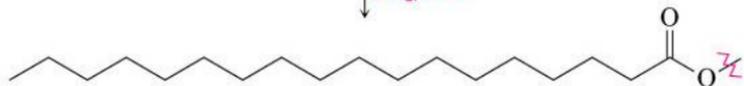


**FIGURA 7.9** Meccanismo di idrogenazione degli alcheni. La reazione avviene con stereochimica sin sulla superficie delle particelle insolubili di catalizzatore.





**Estere dell'acido linoleico (un costituente dell'olio vegetale)**



**Estere dell'acido stearico**

