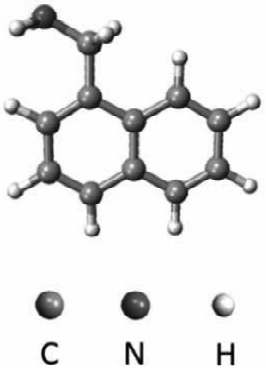
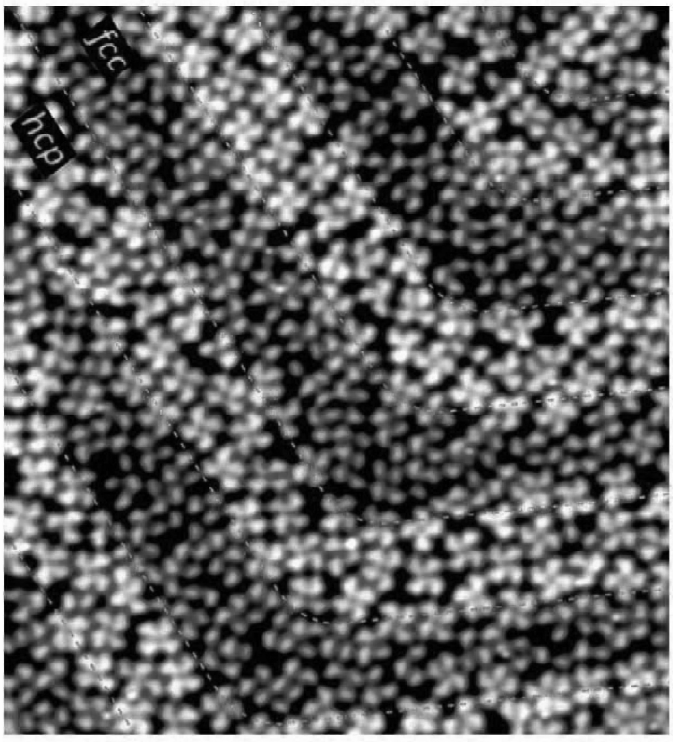
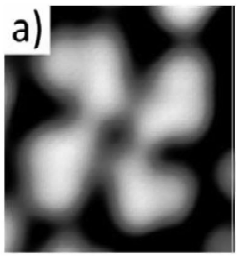
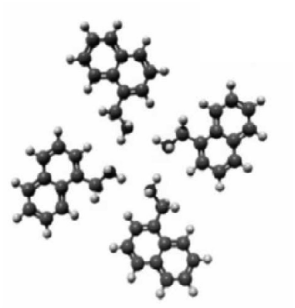
Naphthylmethyl amine (NMA)



on Au(111)







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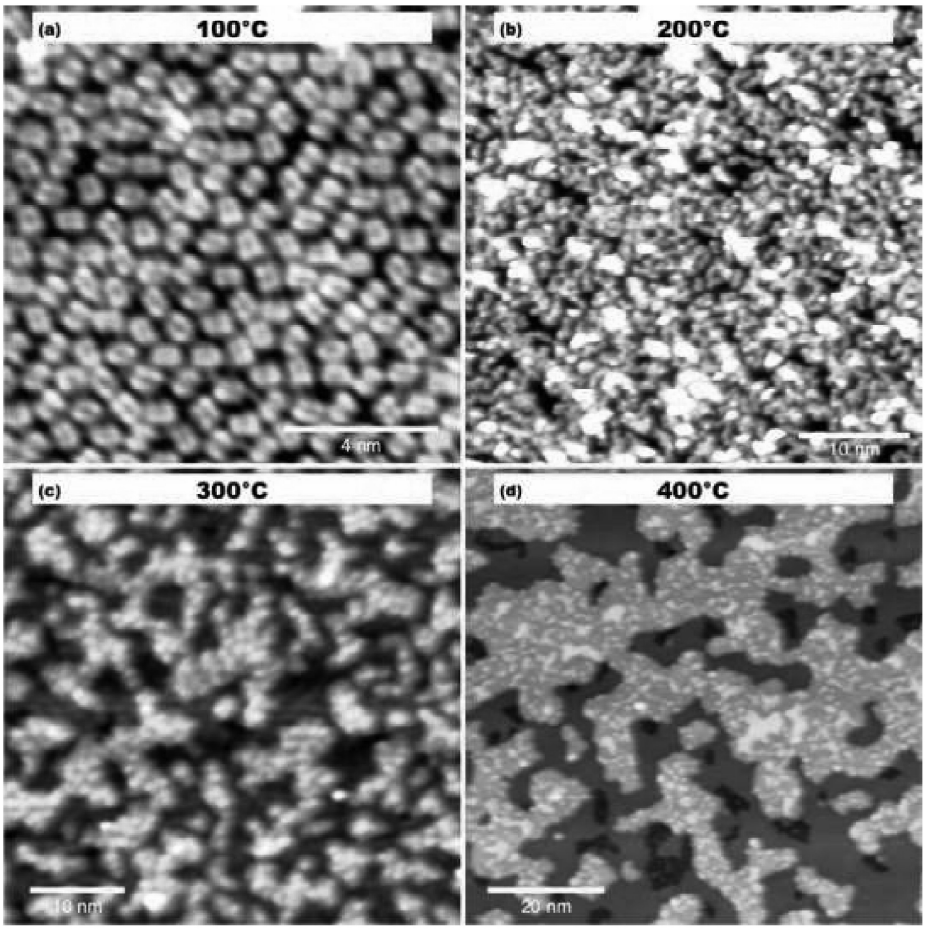
on Ni(111)…



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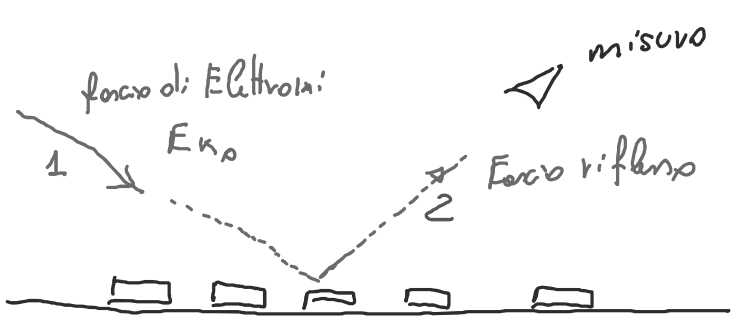
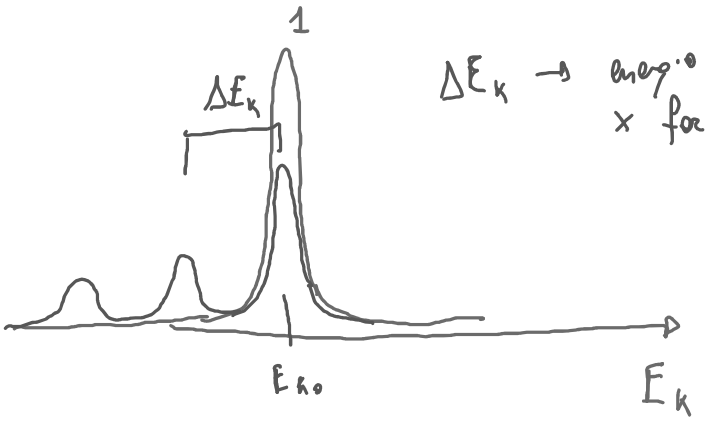
EELS

Electron Energy Loss Spectroscopy





ΔE_K → energia persa (loss) x far fare salto vibrazionale a molecola

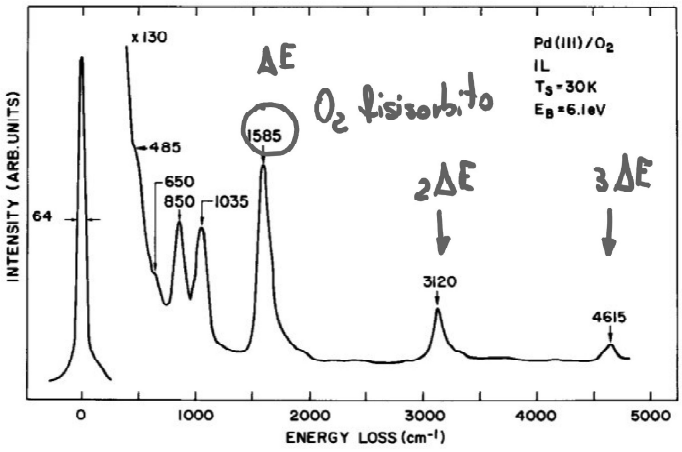
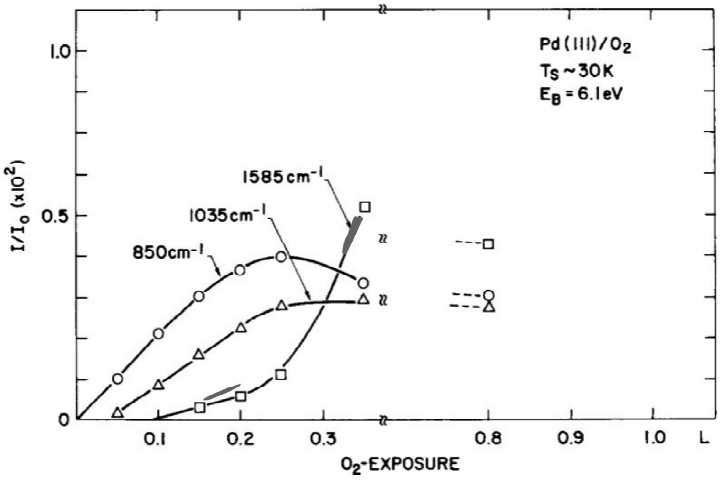
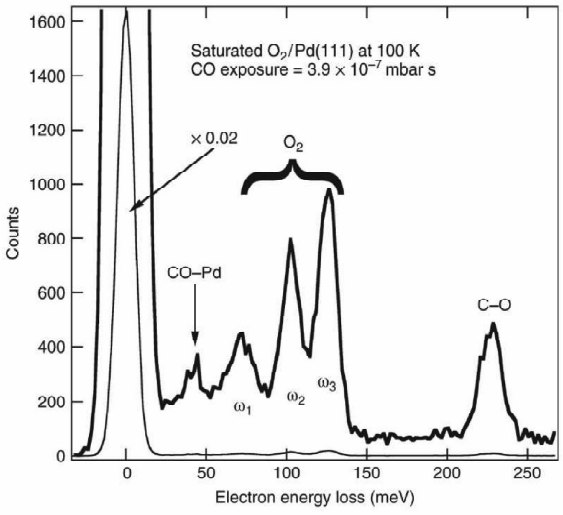
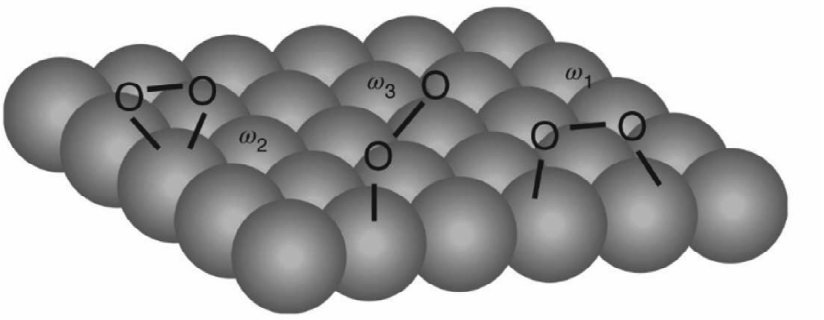
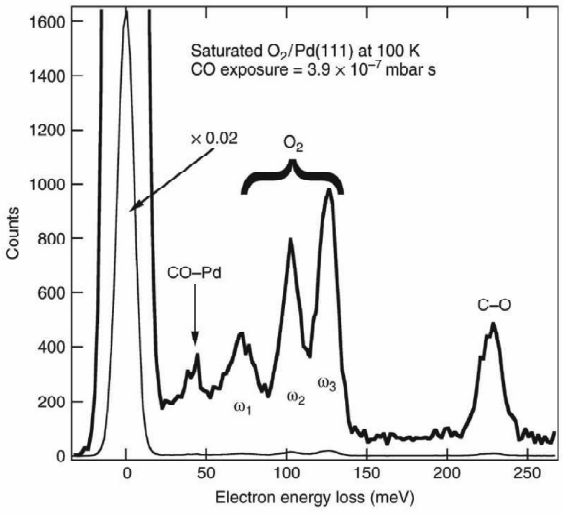


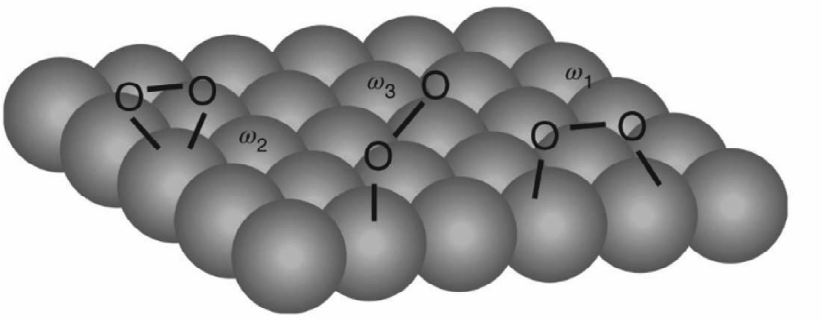
Fig. 1. Loss spectrum of molecular oxygen adsorbed at $T = 30$ K on Pd(111).

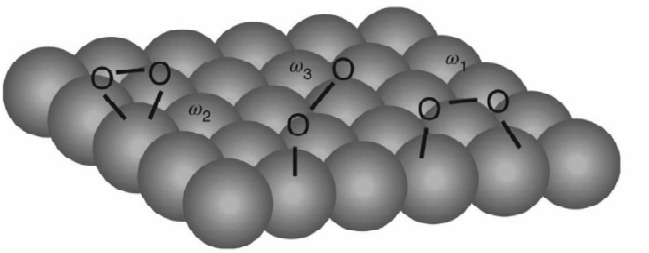


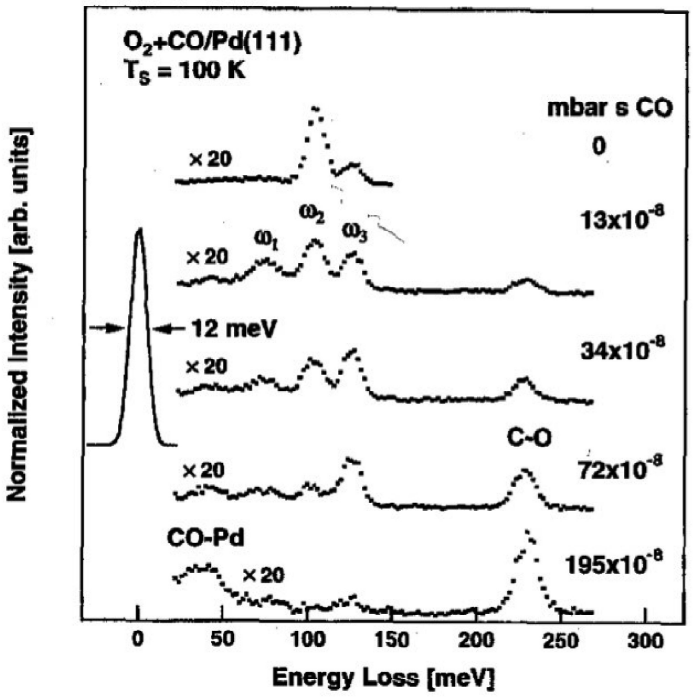

Saturated O2/Pd(111) at 100 K
CO exposure = 3.9 × 10−7 mbar s
× 0.02
O2
CO–Pd
C–O
ω1
ω2
ω3
Counts
Electron energy loss (meV)
0
200
400
600
800
1000
1200
1400
1600
0
50
100
150
200
250


ω3
ω1
ω2


Saturated O2/Pd(111) at 100 K
CO exposure = 3.9 × 10−7 mbar s
× 0.02
O2
CO–Pd
C–O
ω1
ω2
ω3
Counts
Electron energy loss (meV)
0
200
400
600
800
1000
1200
1400
1600
0
50
100
150
200
250


ω3
ω1
ω2


O
O
O
O
O
O
ω_1
ω_2
ω_3


O_2+CO/Pd(111)
T_S = 100 K
mbar s CO
0
×20
$13x10^{-8}$
ω_1
ω_2
ω_3
12 meV
$34x10^{-8}$
C-O
$72x10^{-8}$
CO-Pd
$195x10^{-8}$
Normalized Intensity [arb. units]
0
50
100
150
200
250
300
Energy Loss [meV]

Nella spettroscopia ad infrarosso (IR), un fascio di fotoni con $h\nu$ nell'infrarosso viene usato per attivare dei modi vibrazionali.

Si dimostra che, affinché una vibrazione sia attivabile, deve esserci un dipolo elettrico associato alla molecola che cambia per effetto della vibrazione.

Ad esempio, una molecola di CO, non essendo simmetrica, avrà un certo momento di dipolo μ, che varierà per effetto di una sua vibrazione.

Per molecole su superfici, vibrazioni lungo direzioni parallele alla superficie non sono IR attivabili per effetto della cosiddetta immagine:

Il dipolo immagine annulla il dipolo della molecola.

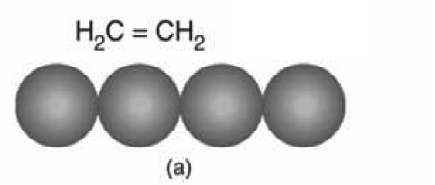
$\Rightarrow$ una vibrazione non può essere attivata con fotone IR

Viceversa:

per dipoli $\perp$ alla superficie, il loro valore viene aumentato dal dipolo immagine

La spettroscopia IR "vede" solo moti vibrazionali $\perp$ alla superficie

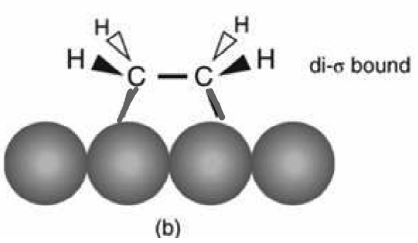
Etilene su Pt(111)



Ts < 50 K

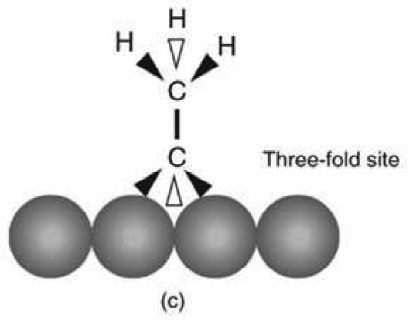
Fisisorbimento
(-73KJ/mole, 0.7 eV/moc)

Vibrazioni CH non visibili



Ts > 50 K

IR: C-H visibile
(-117 KJ/mole)



Ts > 280 K

IR: C-C visibile