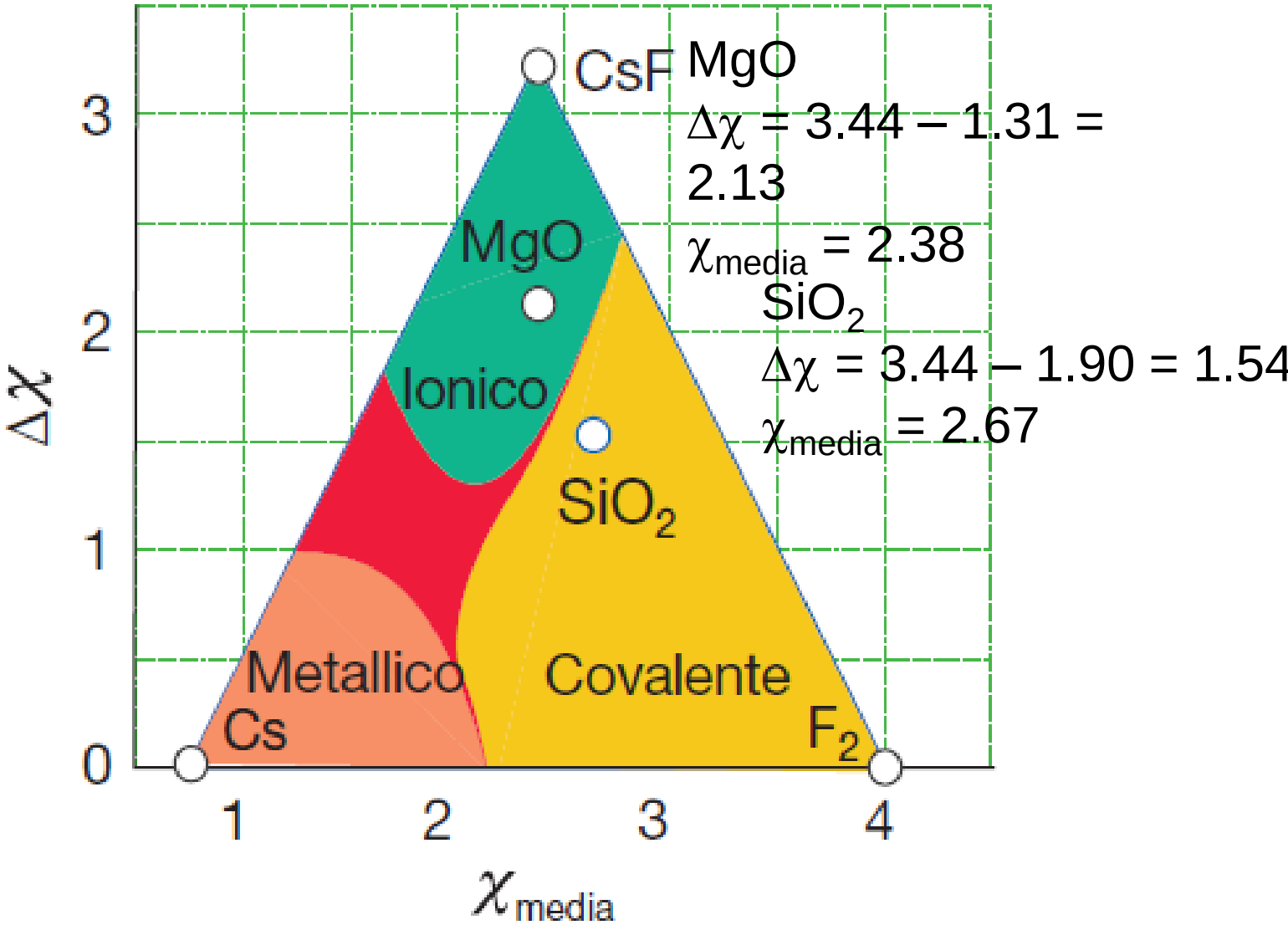
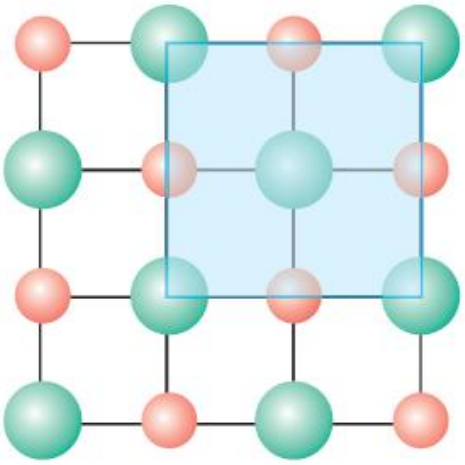
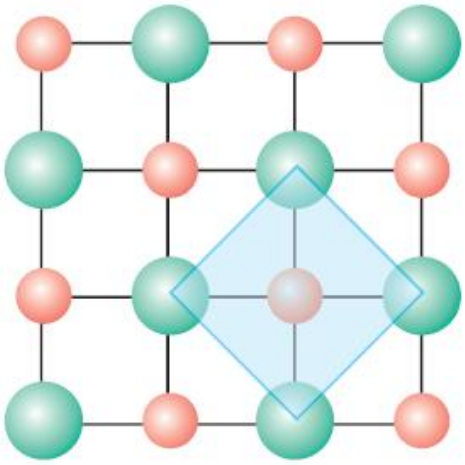


Triangolo di Ketelaar

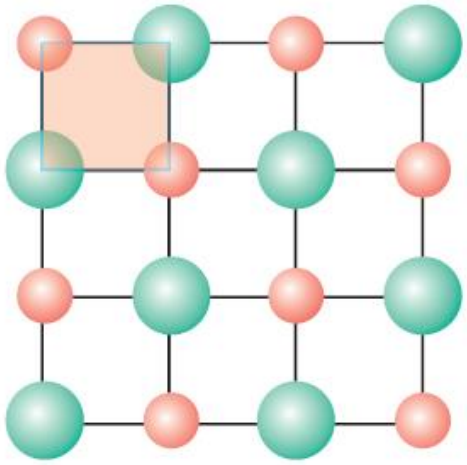
Celle unitarie bidimensionali



(a) Possibile cella unitaria



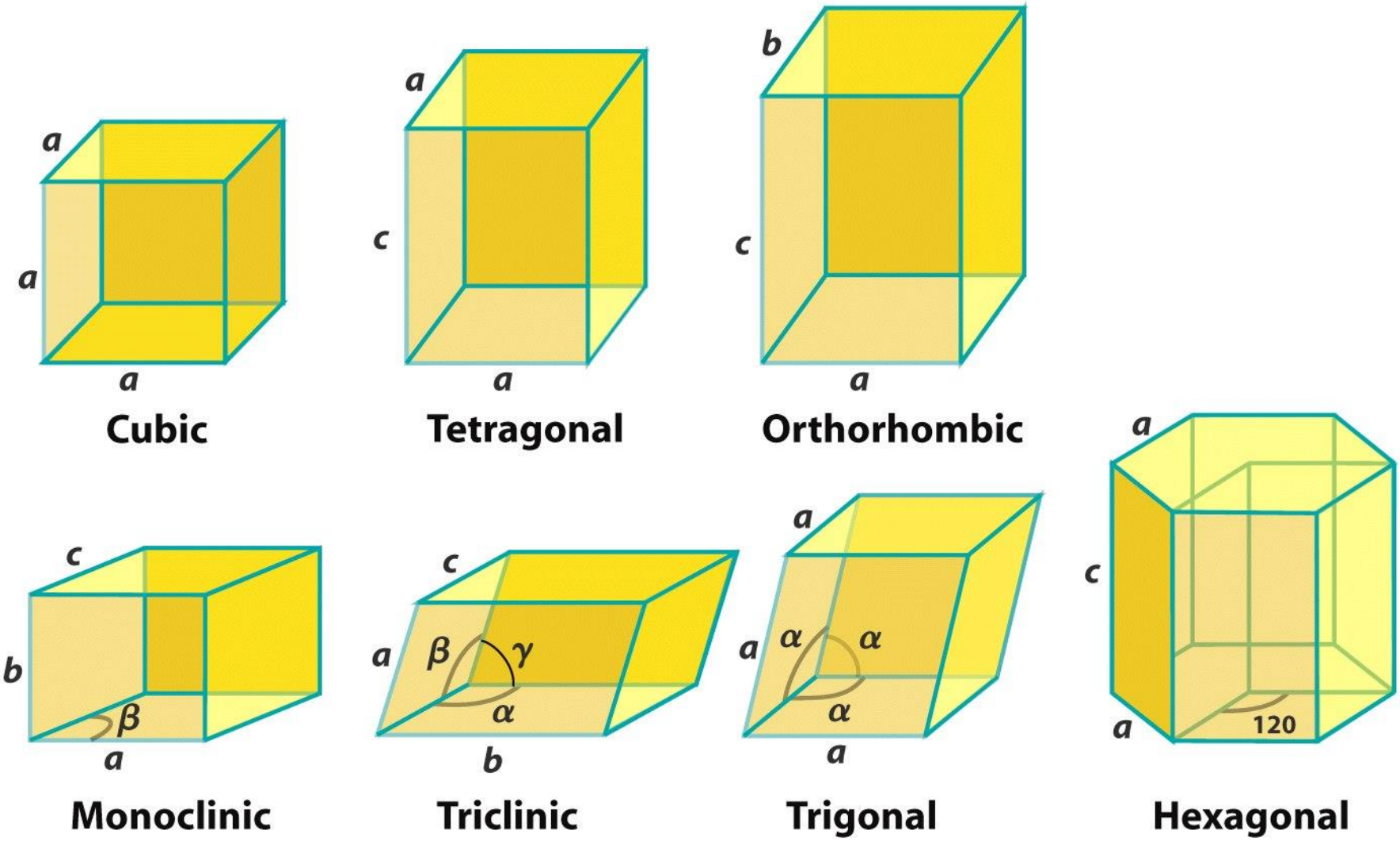
(b) Scelta preferita per la cella unitaria



(c) Non è una cella unitaria

Preferita

I 7 sistemi cristallini



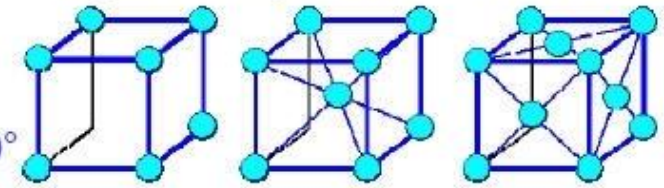
I 14 reticoli di Bravais

Cubico

$a_1 = a_2 = a_3$

$\alpha = \beta = \gamma = 90°$

Semplice Corpo Centrato Facce Centrate

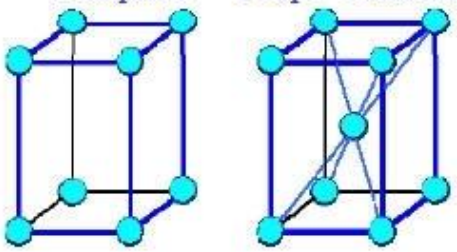


Tetragonale

$a_1 = a_2 \neq a_3$

$\alpha = \beta = \gamma = 90°$

Semplice Corpo Centrato

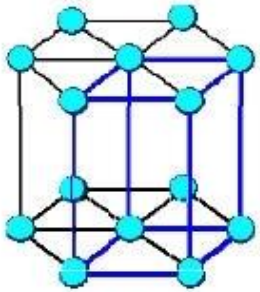


Esagonale

$a_1 = a_2 \neq a_3$

$\alpha = \beta = 90°$

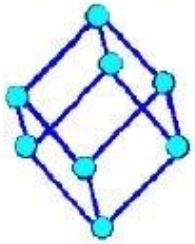
$\gamma = 120°$



Romboedrico

$a_1 = a_2 = a_3$

$\alpha = \beta = \gamma \neq 90°$

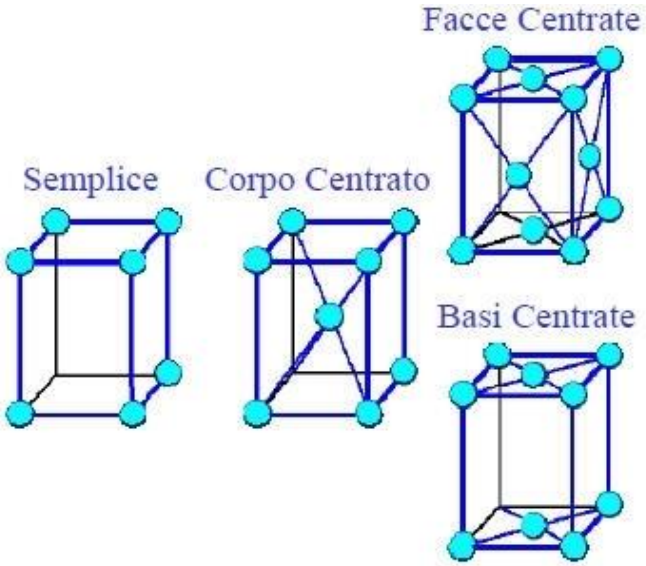


Ortorombico

$a_1 \neq a_2 \neq a_3$

$\alpha = \beta = \gamma = 90°$

Semplice Corpo Centrato Facce Centrate Basi Centrate



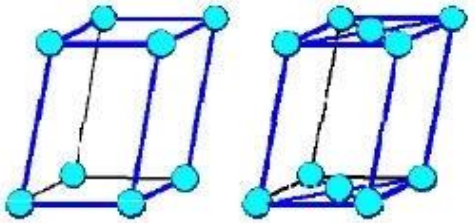
Monoclino

$a_1 \neq a_2 \neq a_3$

$\alpha = \beta = 90°$

$\gamma \neq 90°$

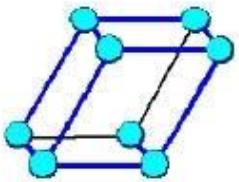
Semplice Basi Centrate



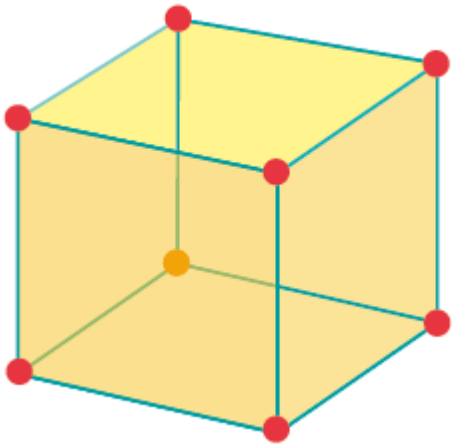
Triclino

$a_1 \neq a_2 \neq a_3$

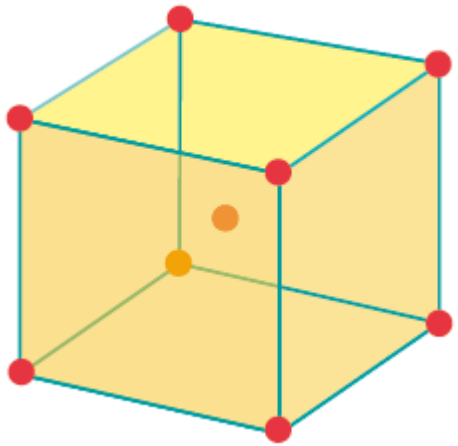
$\alpha \neq \beta \neq \gamma \neq 90°$



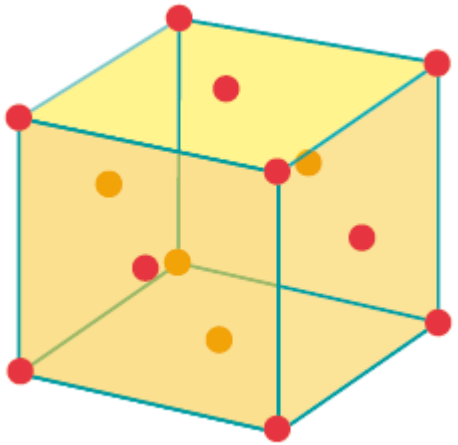
Celle unitarie cubiche



Cubica primitiva, P

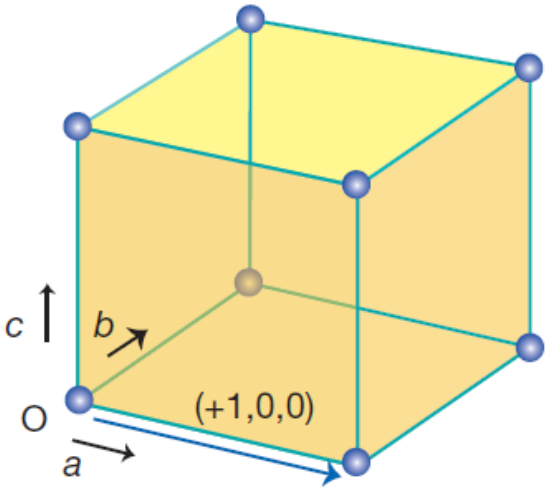


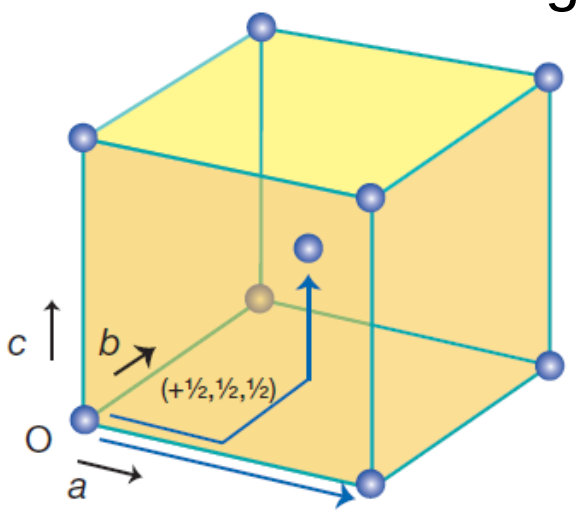
Cubica a corpo centrato, I

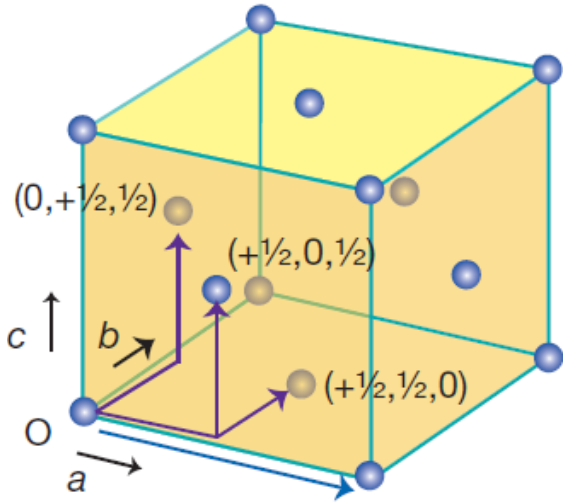


Cubica a facce centrate, F

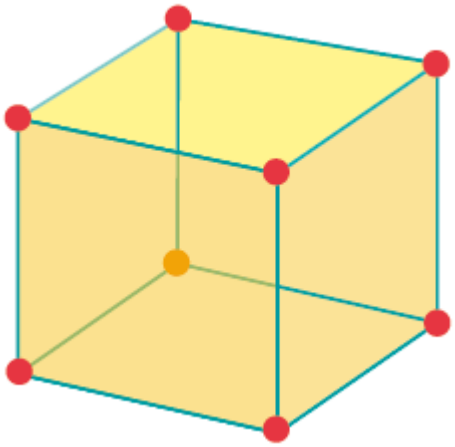
Simmetrie traslazionali aggiuntive



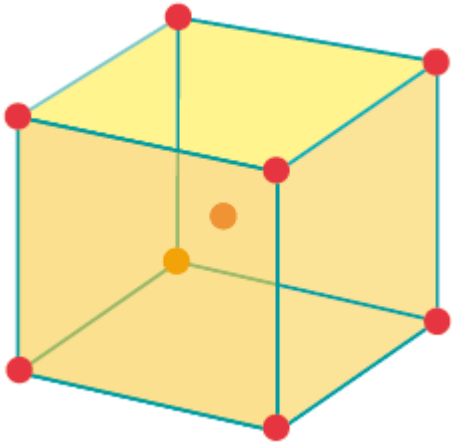




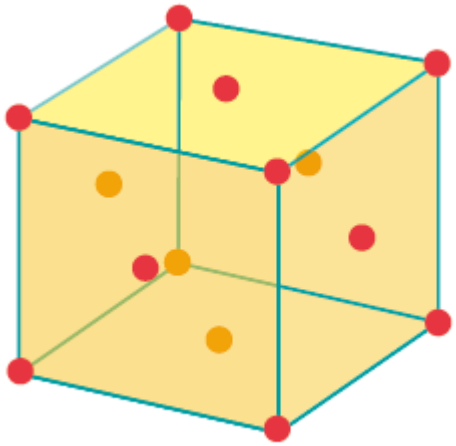
Celle unitarie cubiche



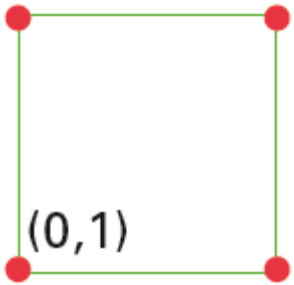
Cubica primitiva, P

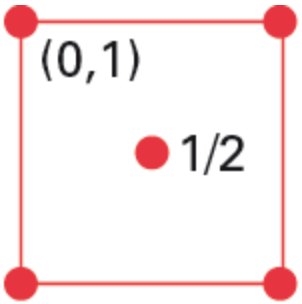


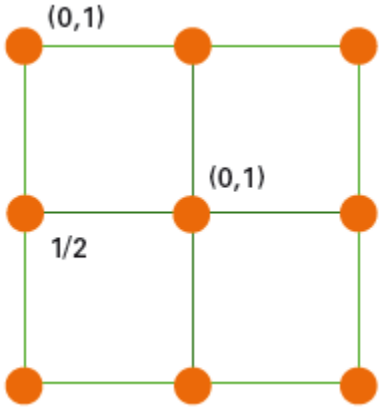
Cubica a corpo centrato, I



Cubica a facce centrate, F

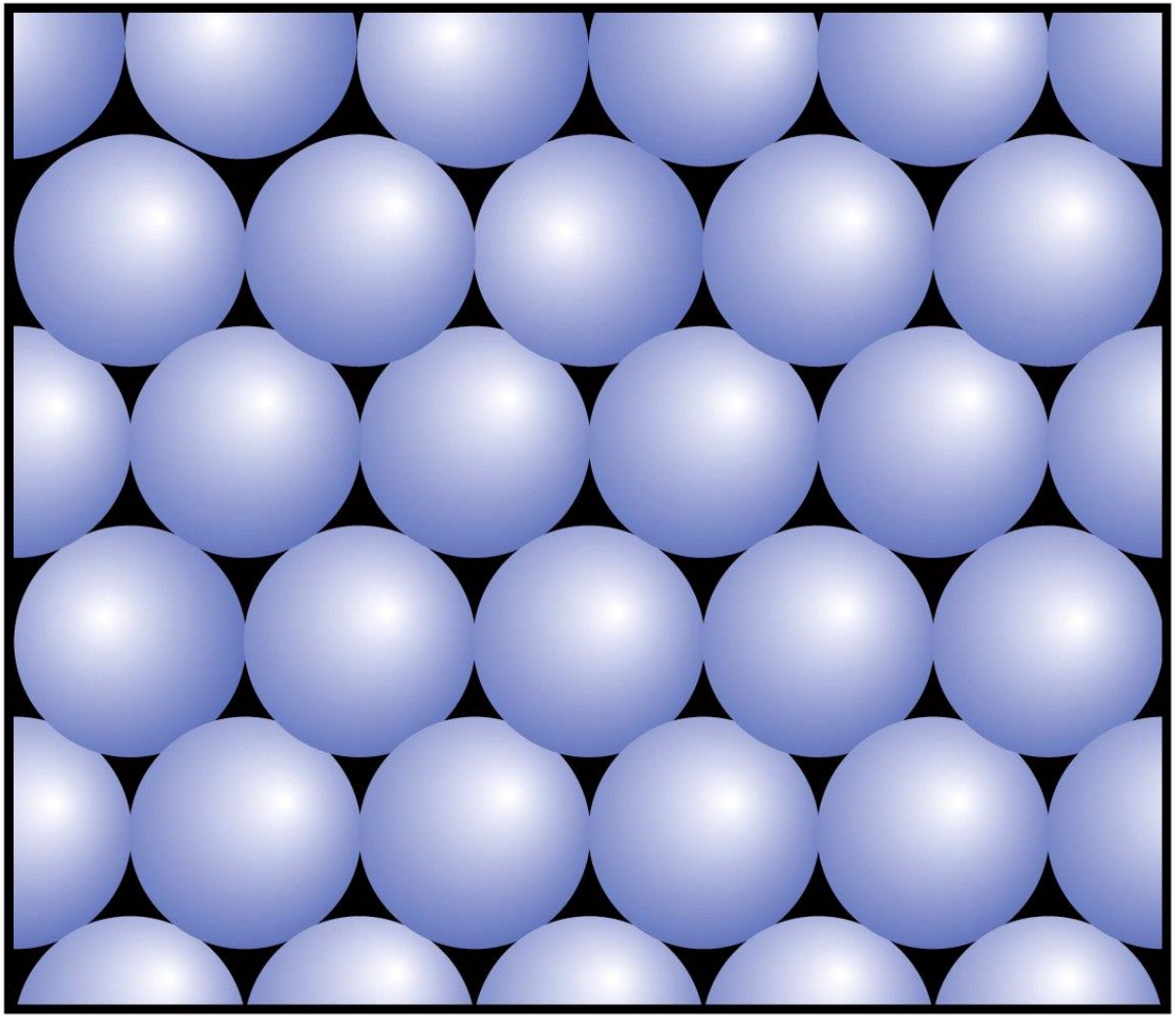




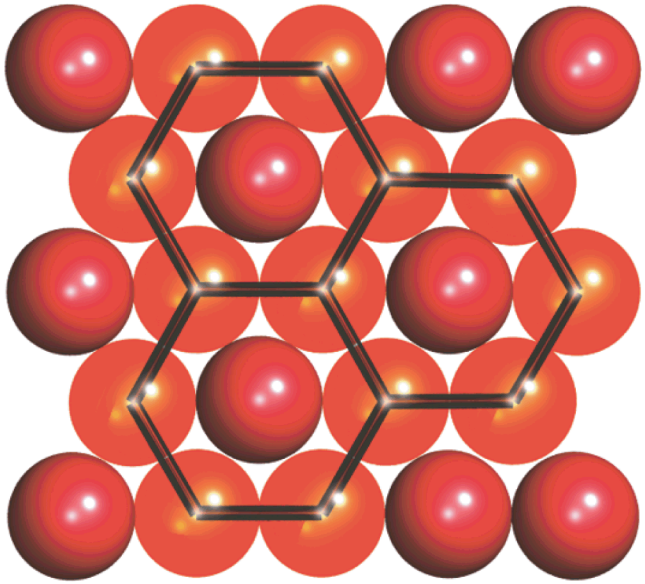


Coordinate frazionarie

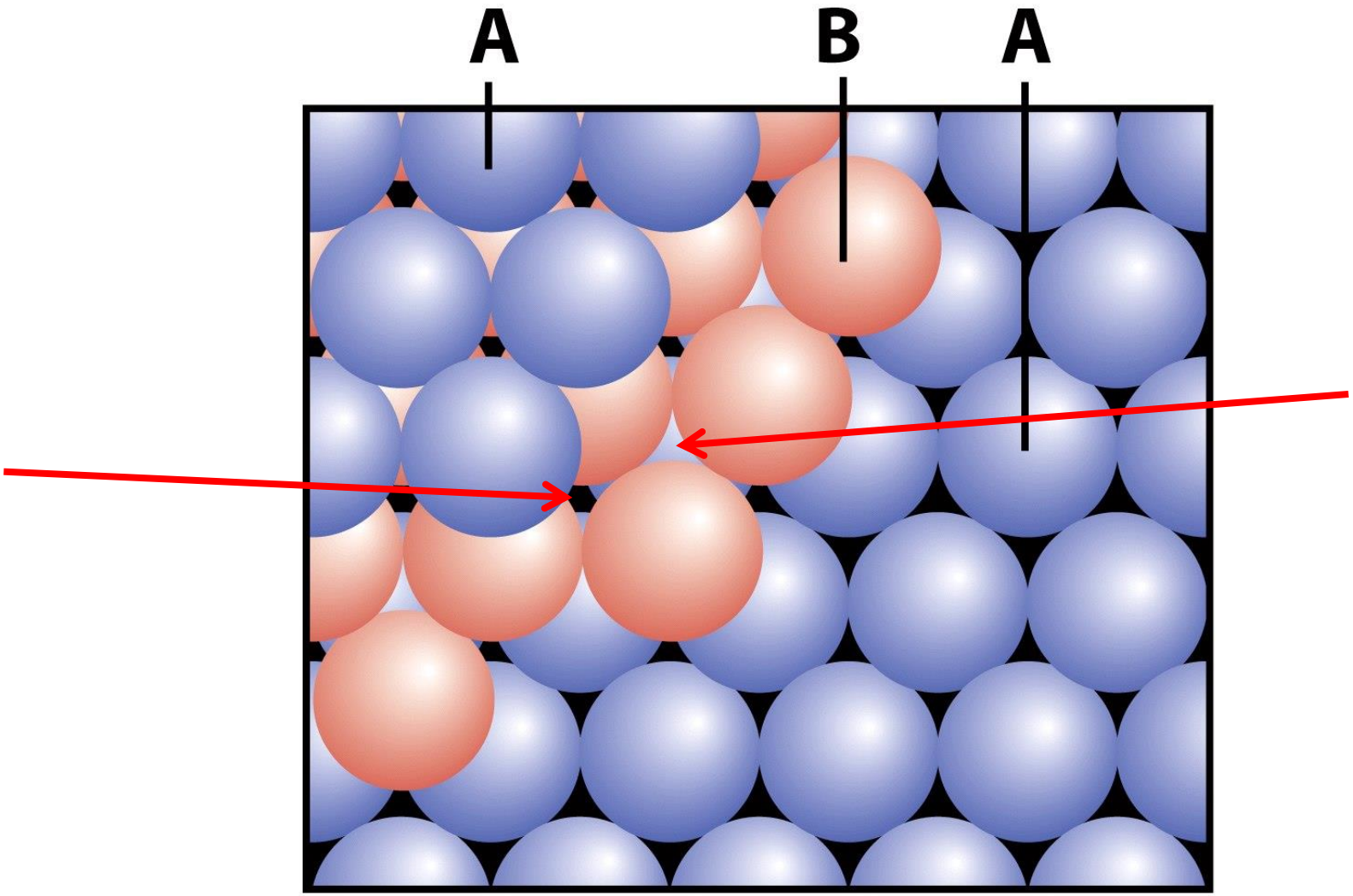
Impaccamento compatto di sfere rigide



Strato di sfere a impaccamento compatto con evidenzia
la coordinazione esagonale



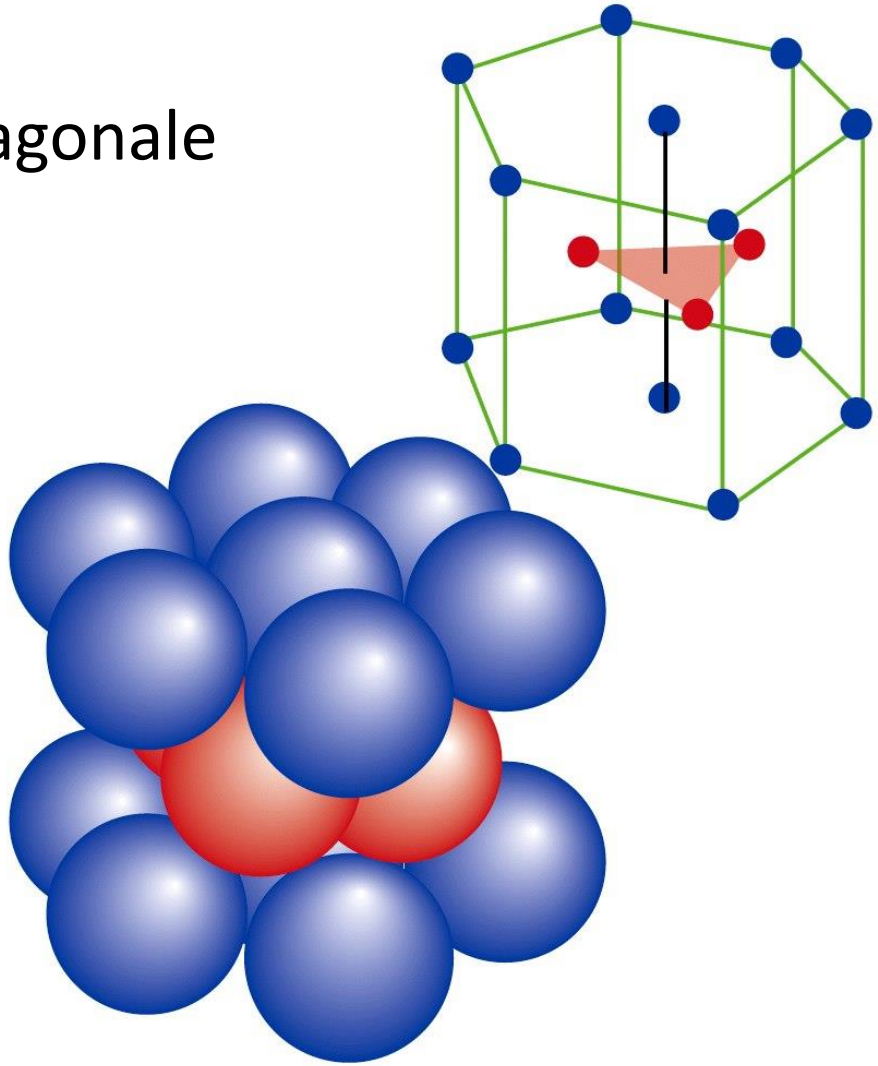
Politipi a impaccamento compatto: ABAB….
Esagonale compatto (*hcp*)



Impaccamento esagonale compatto (*hcp*)

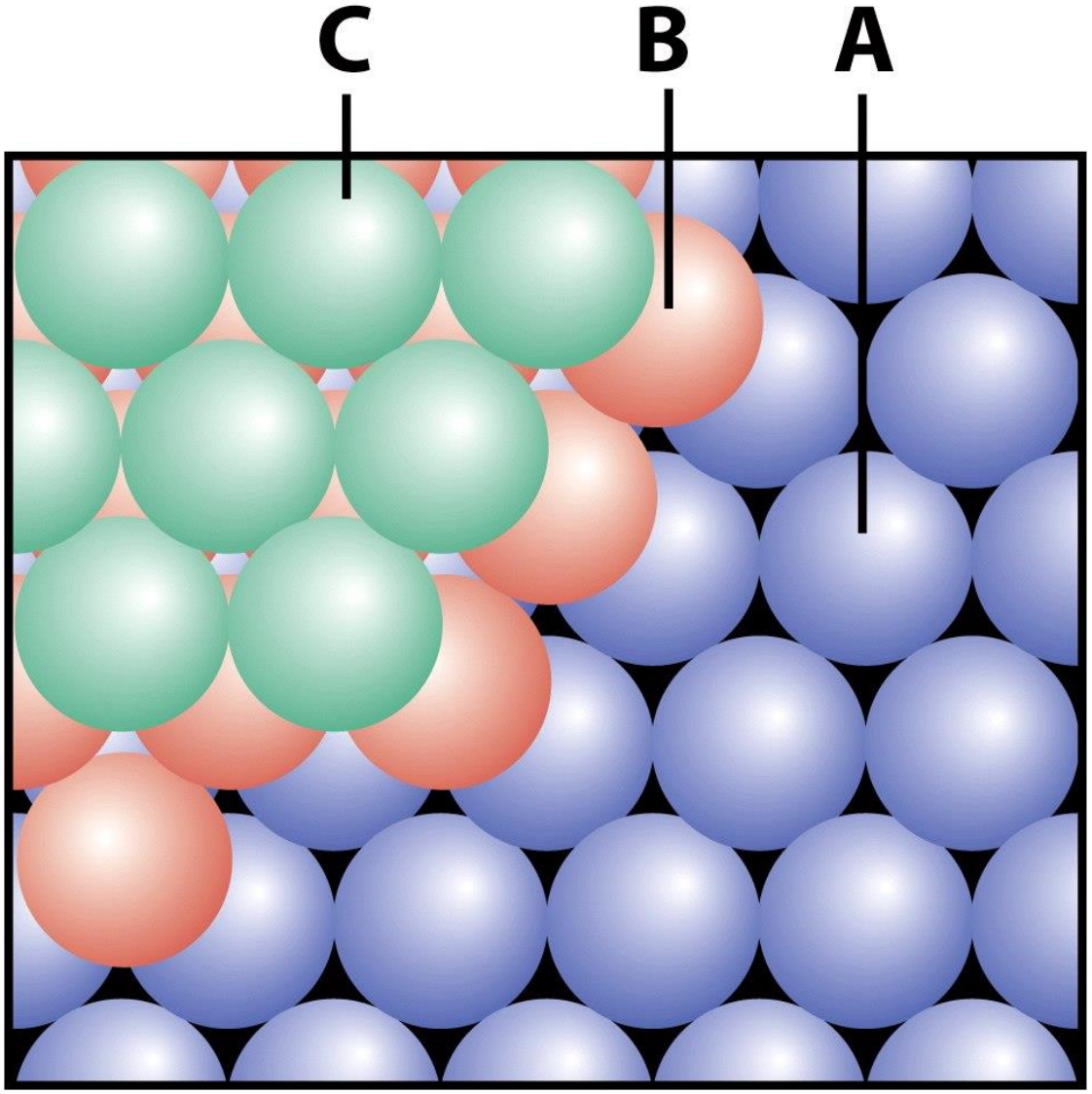
hexagonally close packed

Cella unitaria esagonale



Politipi a impaccamento compatto: ABCABC….

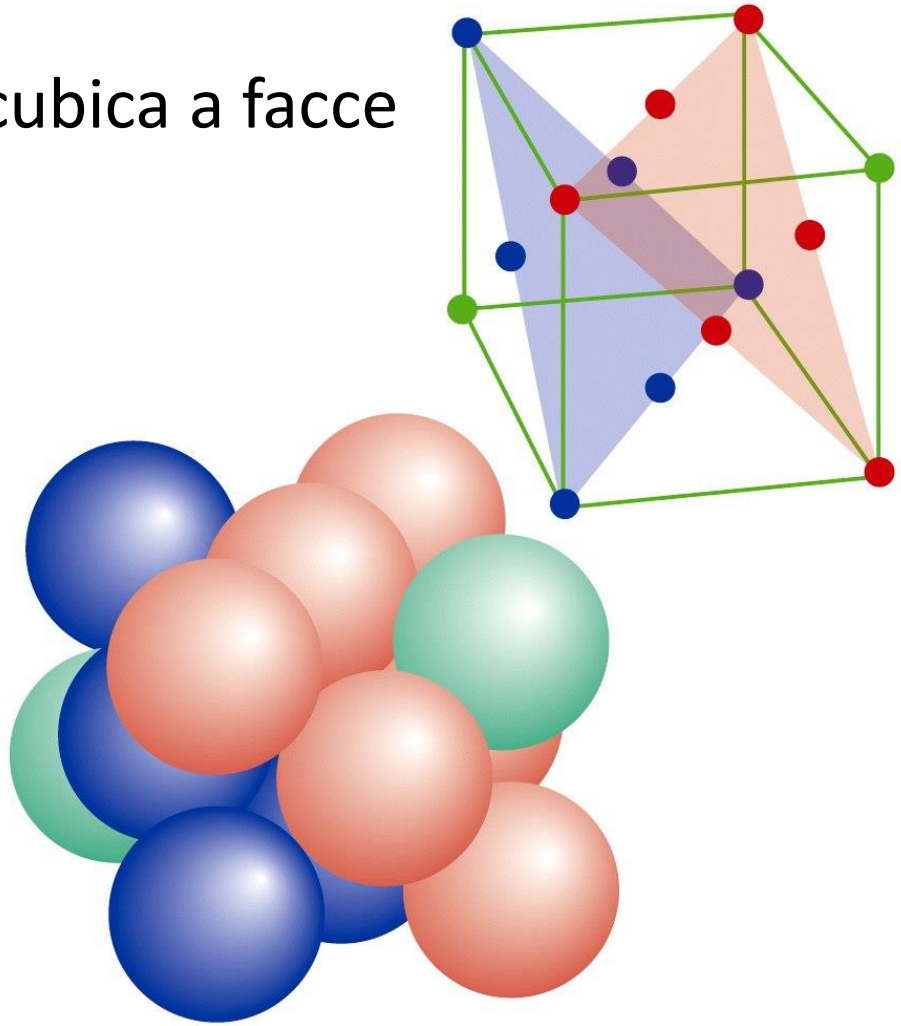
Cubico compatto (*ccp*)



Impaccamento cubico compatto (*ccp*)

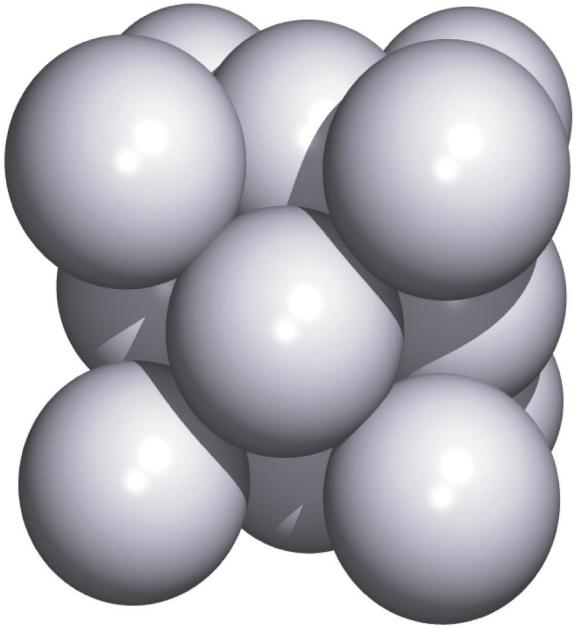
cubic close packed

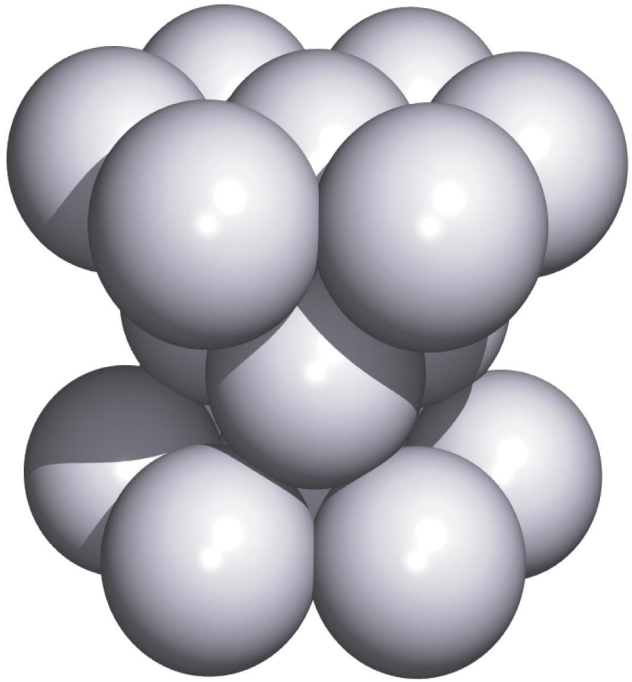
Cella unitaria cubica a facce centrate (fcc)



Celle unitarie fcc e hcp a confronto

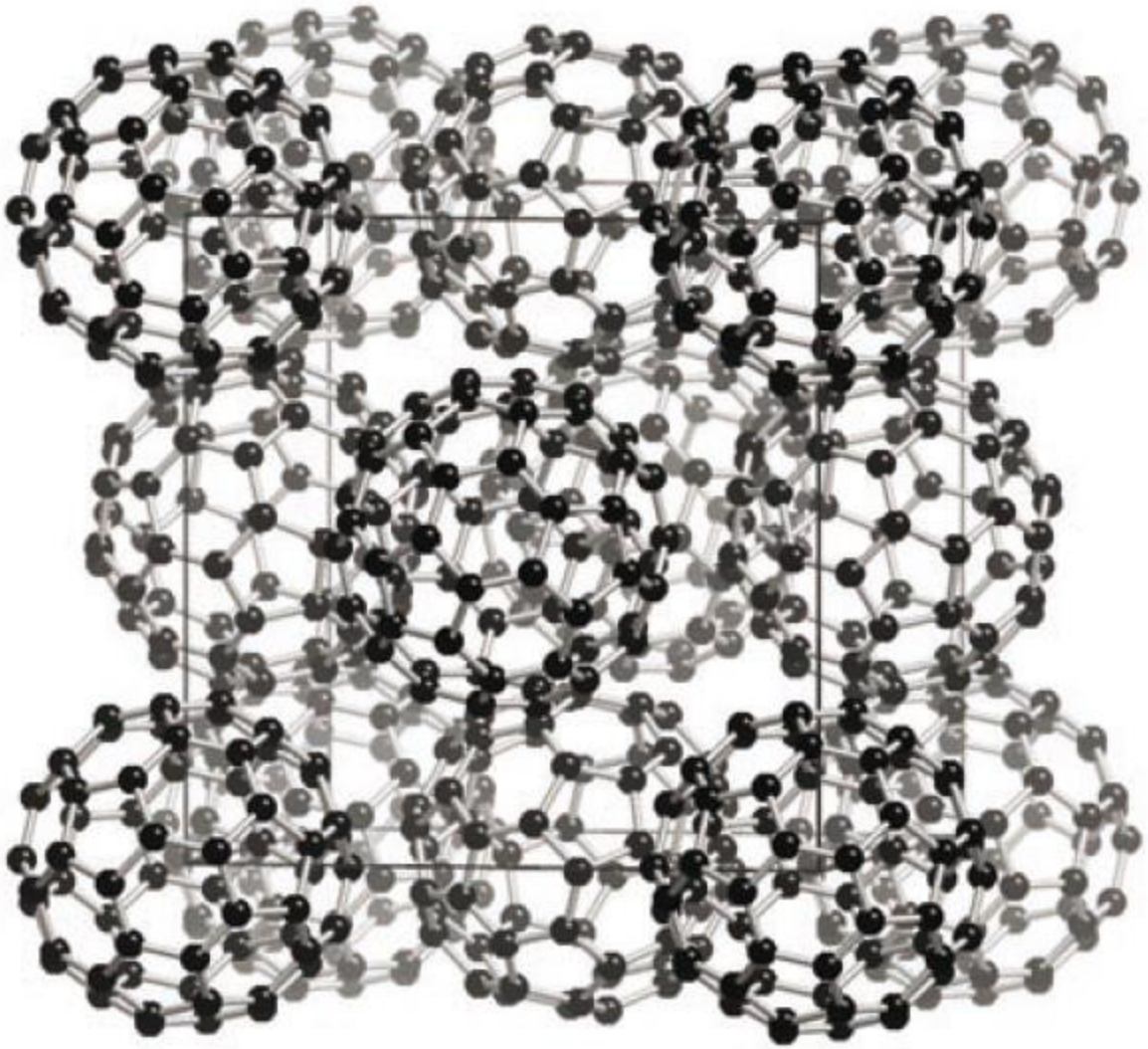
Numero di coordinazione 12



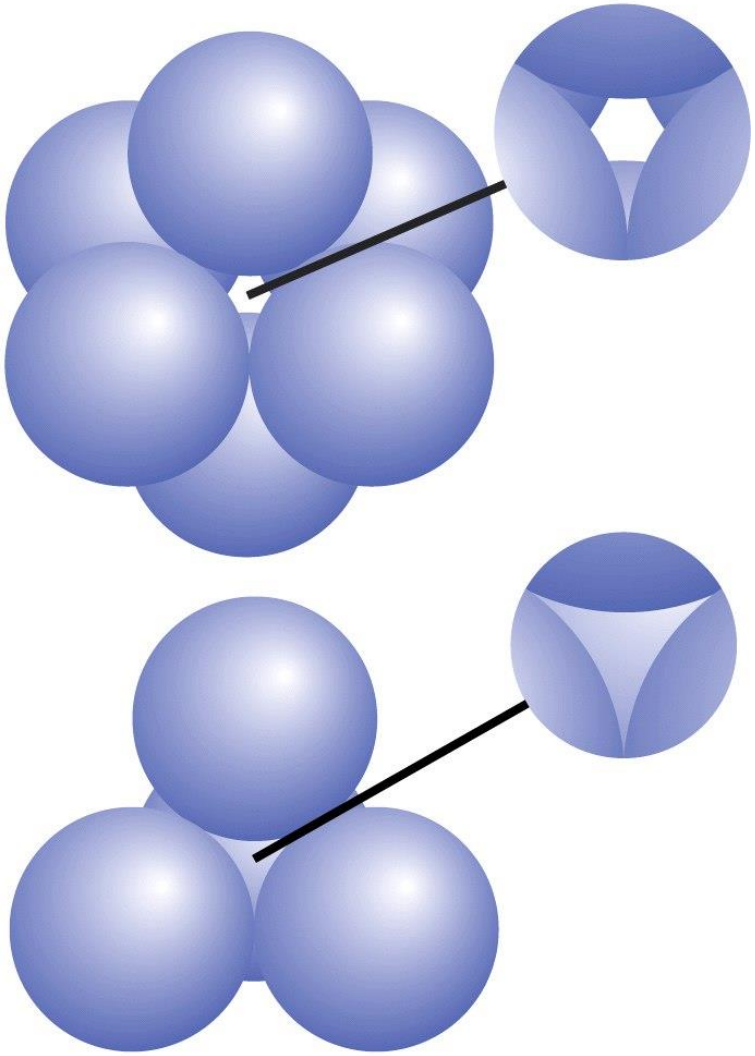


Spazio vuoto = 26%

Arrangiamento ccp di C_{60}



Interstizi negli impaccamenti compatti

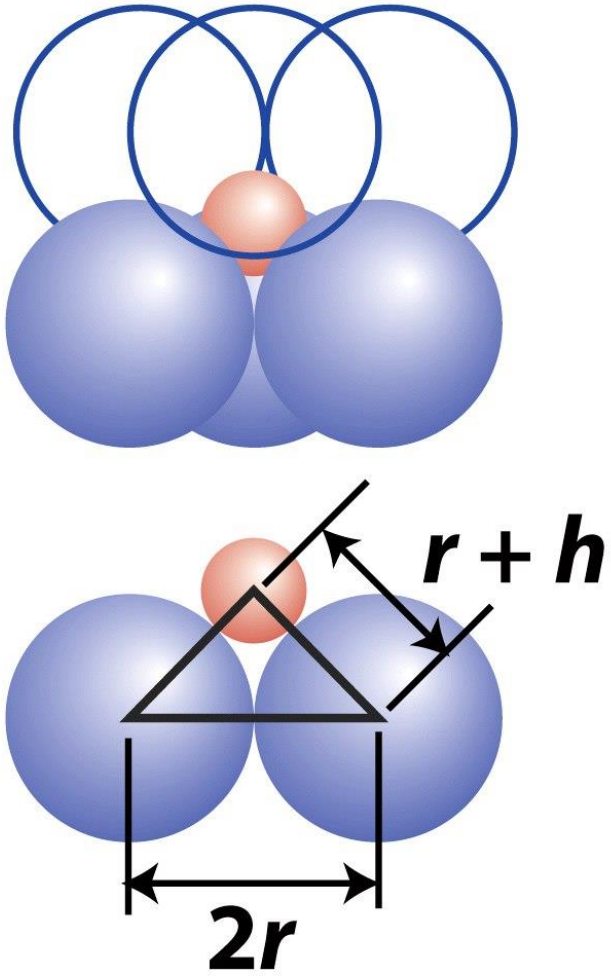


Interstizio ottaedrico

$r_h = 0.414r$

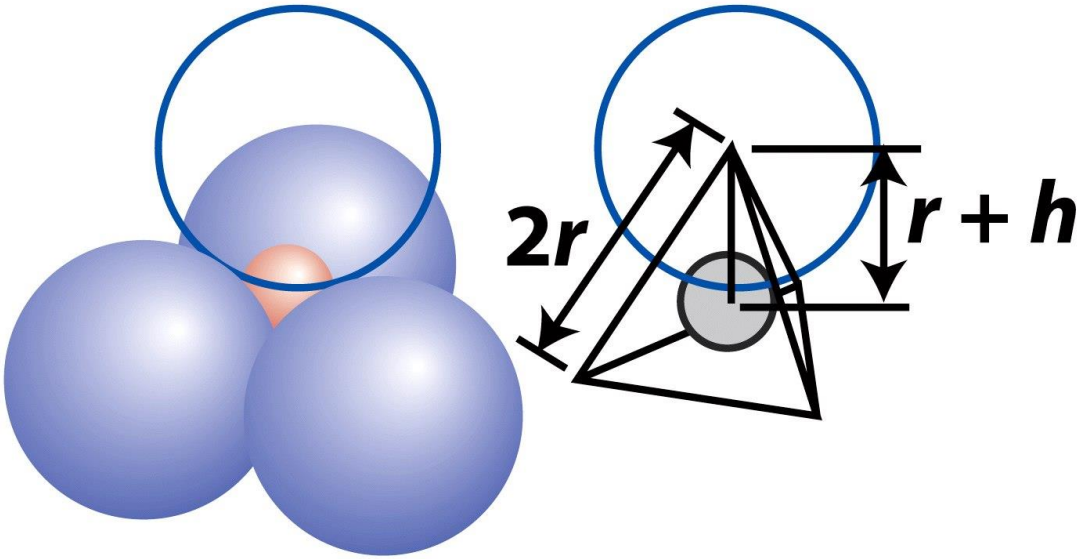
Interstizio tetraedrico

$r_h = 0.225r$



Interstizio ottaedrico

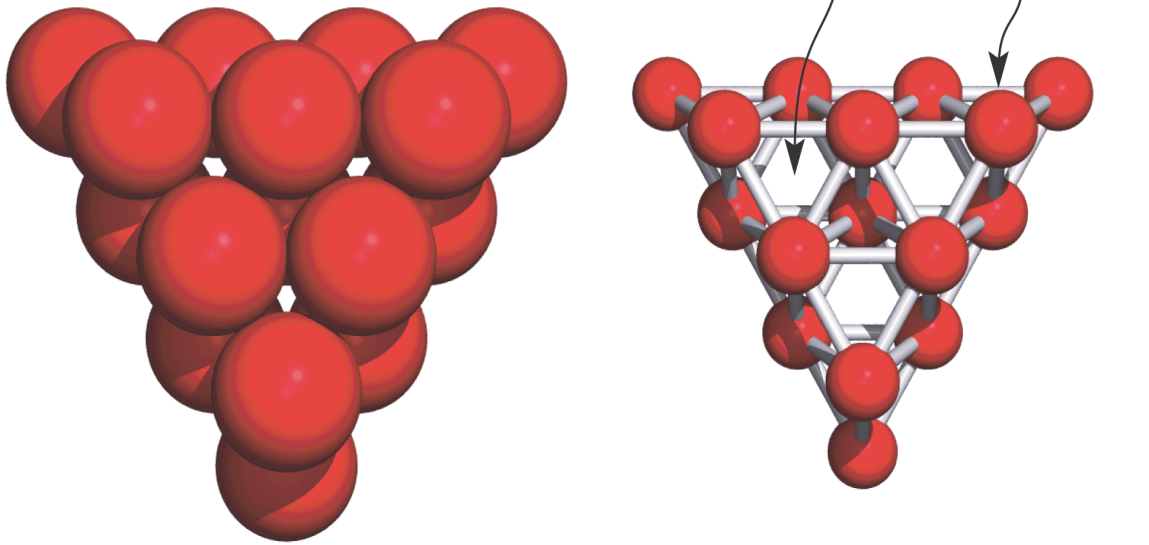
$r_h = 0.414r$



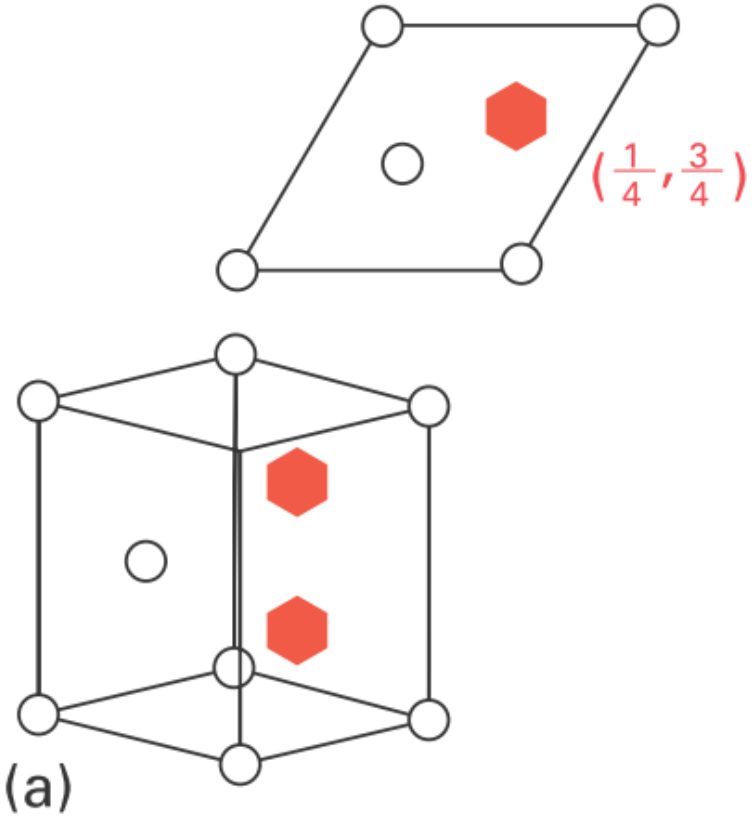
Interstizio tetraedrico

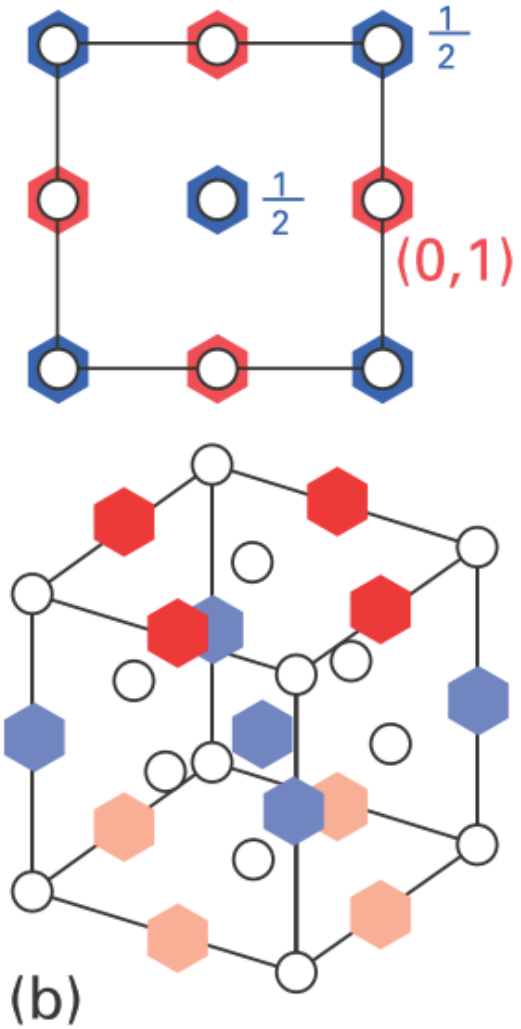
$r_h = 0.225r$

Interstizi ottaedrici e tetraedrici



Interstizi ottaedrici nelle strutture compatte

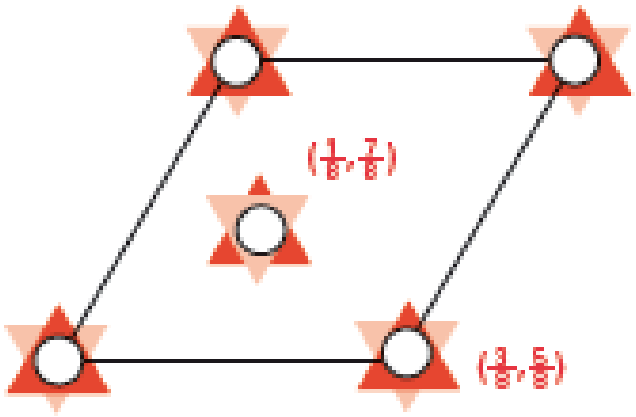


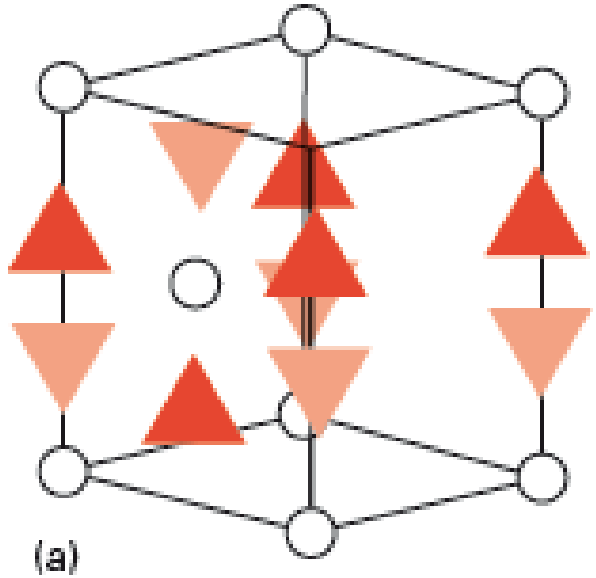


hcp

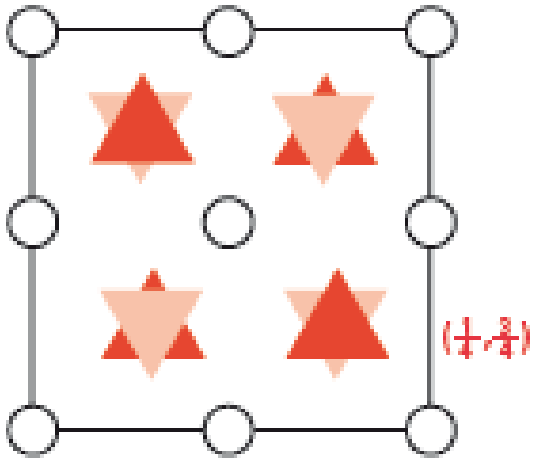
ccp

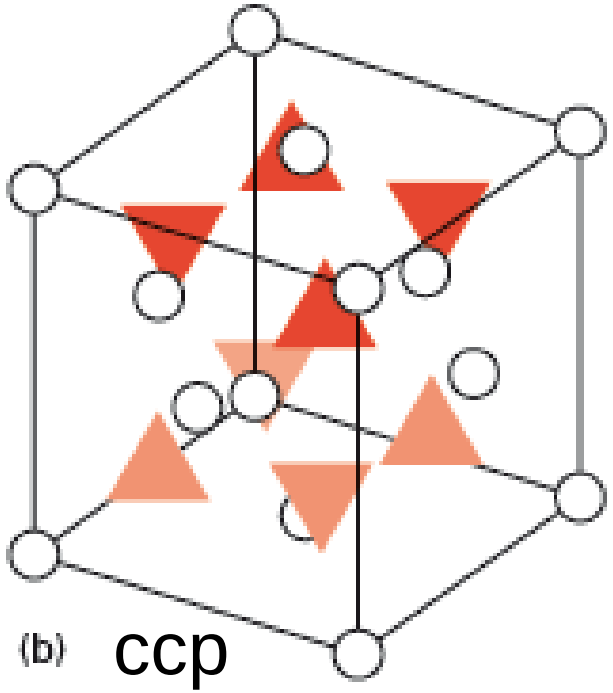
Interstizi tetraedrici nelle strutture compatte





hcp





ccp

Le strutture dei metalli

ρ_{Os} = 22,61 g cm^{-3}

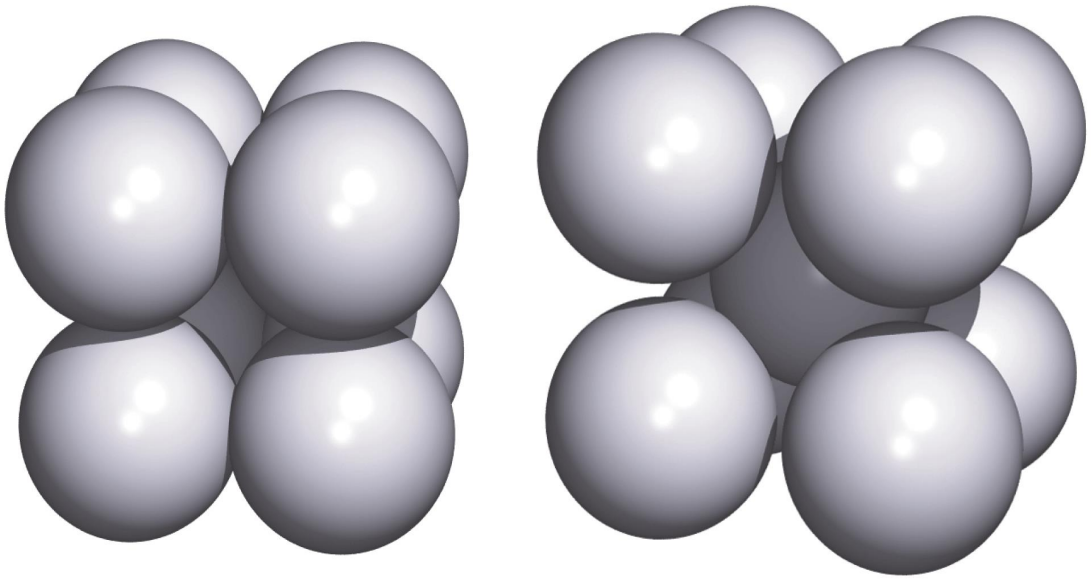
ρ_{Pb} = 11,3 g cm^{-3}

Struttura cristallina	Elemento
Esagonale compatta (hcp)	Be, Ca, Co, Mg, Ti, Zn
Cubica compatta (ccp)	Ag, Al, Au, Cd, Cu, Ni, Pb, Pt
Cubica a corpo-centrato (bcc)	Ba, Cr, Fe, W, metalli alcalini
Cubica primitiva (cubica-P)	Po

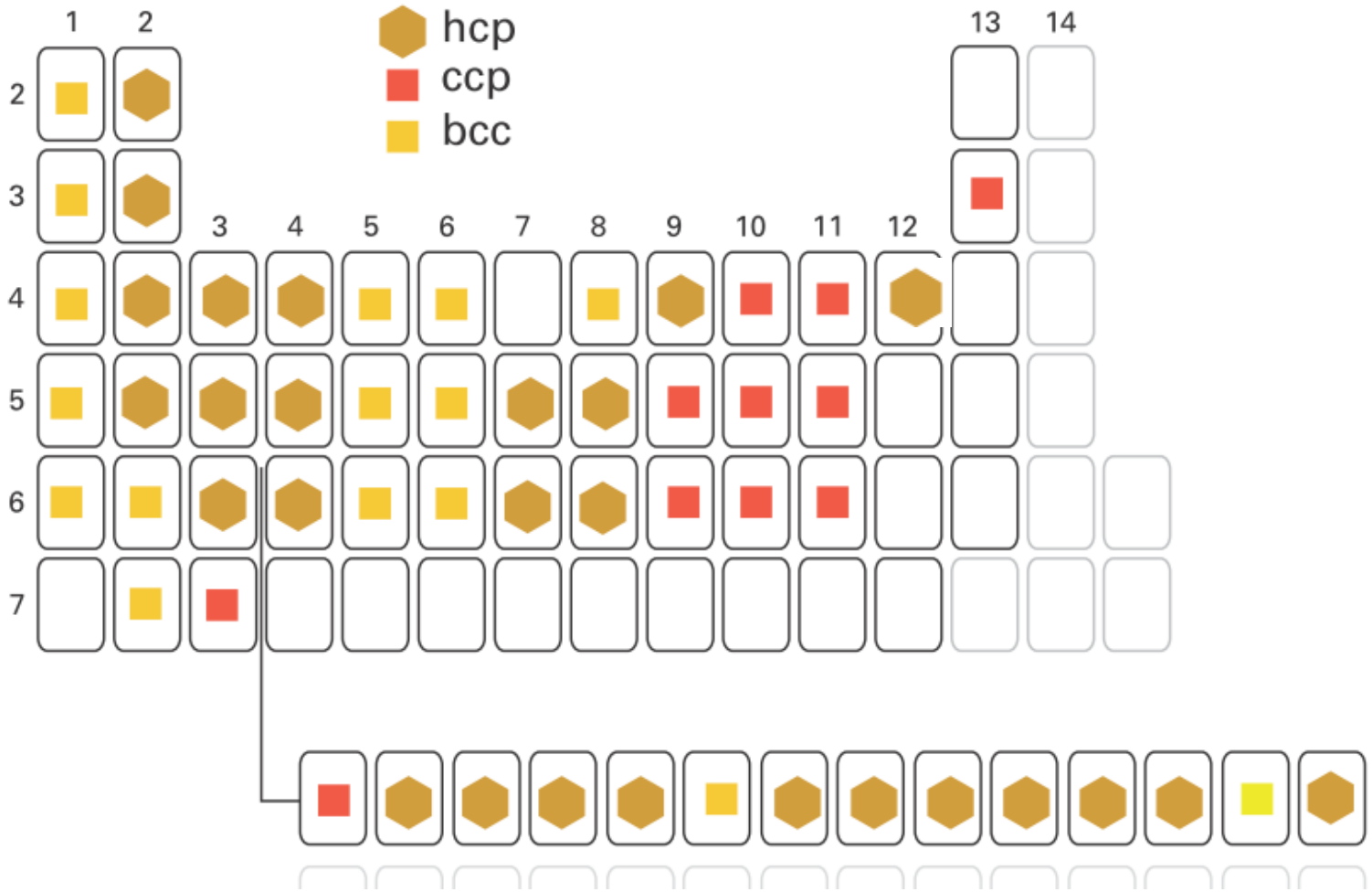
26% vuoto

32% vuoto

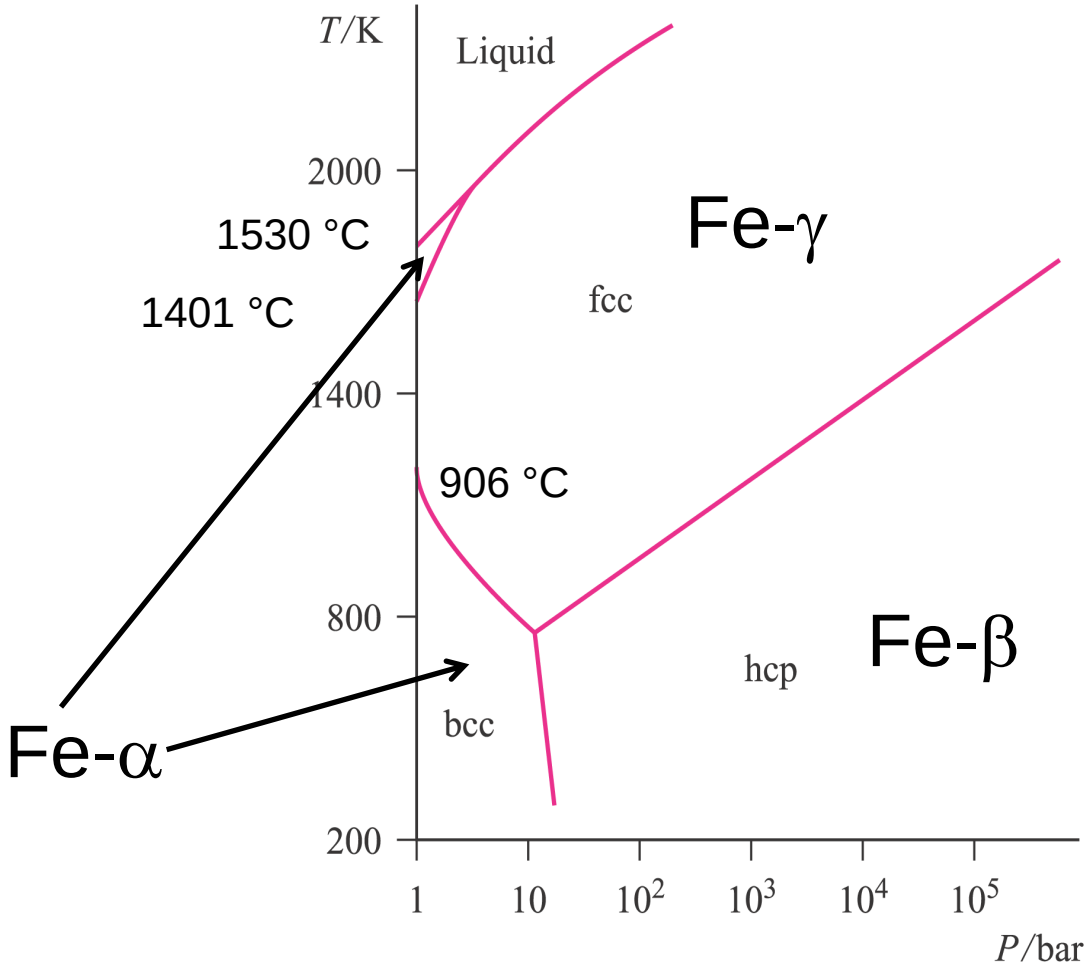
Cubica primitiva



bcc


hcp
ccp
bcc
1
2
3
4
5
6
7
8
9
10
11
12
13
14

Polimorfismo del ferro



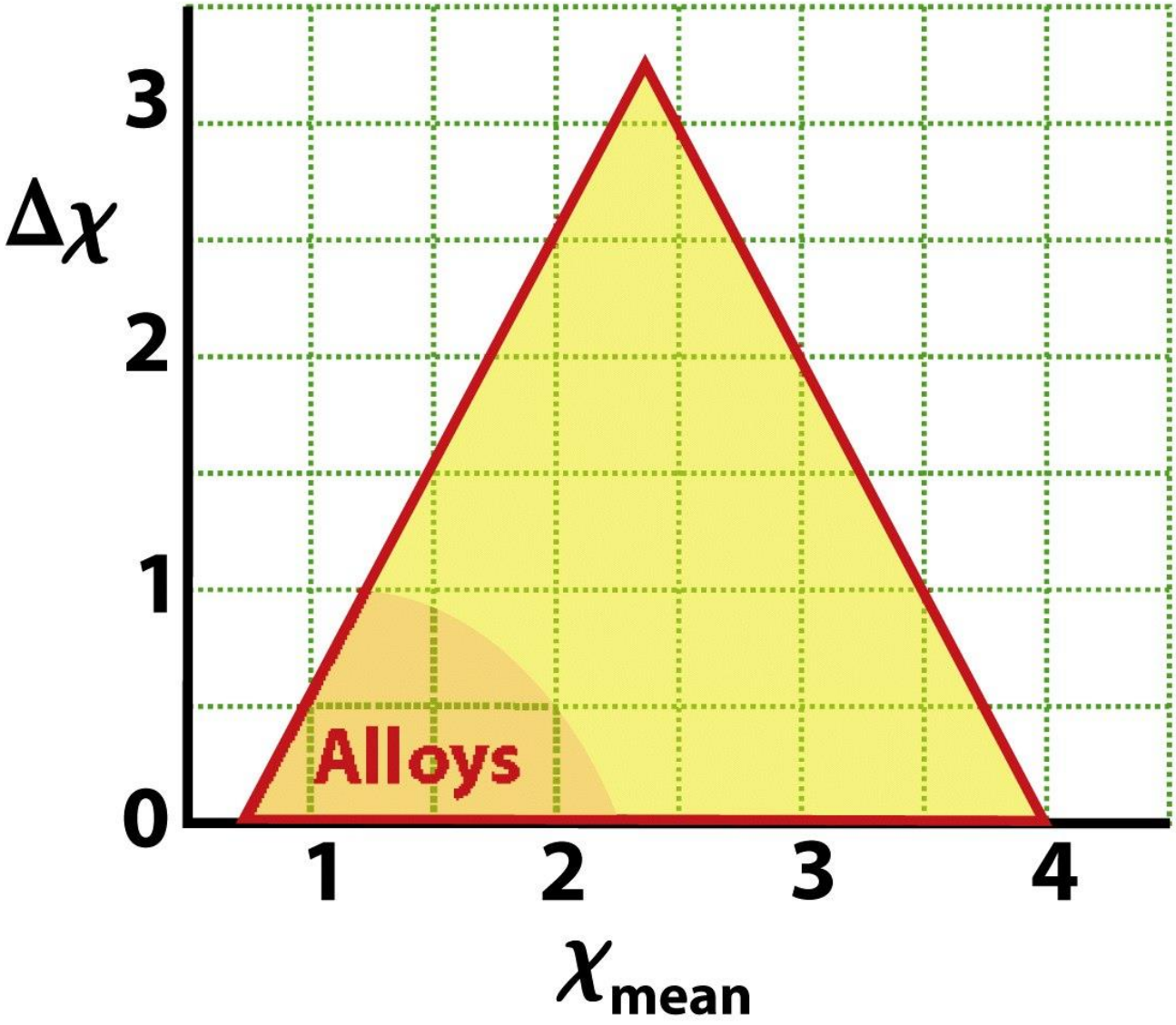
Polimorfismo *= la capacità di adottare forme cristalline diverse in condizioni di pressione e temperatura differenti*

Correzione di Goldschmitd dei raggi atomici

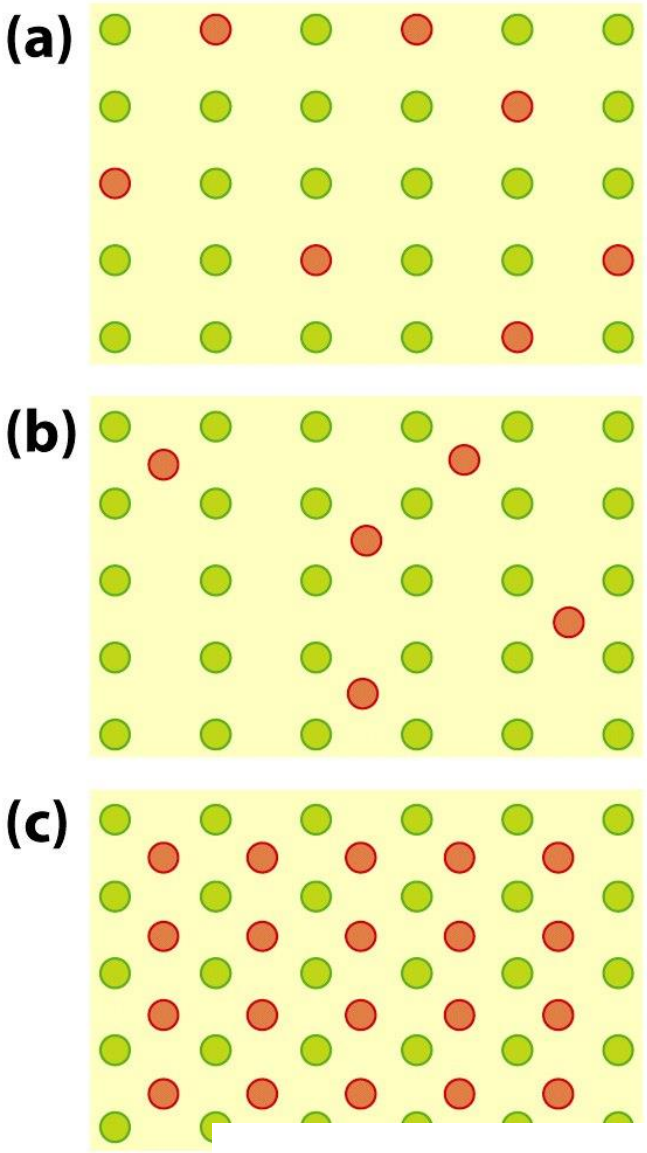
Numero di coordinazione	Raggio relativo
12	1
8	0,97
6	0,96
4	0,88

Correzione di Goldschmidt = raggio metallico (ipotetico) in una struttura a impaccamento compatto con coordinazione 12.

Leghe metalliche



Leghe metalliche



Soluzioni solide **sostituzionali**

$\Delta r < 15\%$

(e.g. Cu/Ni, Cu/Sn/Pb (85/10/5, bronzo), Cu_{1-x}/Zn_x, $0 < x < 0.38$ (ottoni α), acciai inox)

Soluzioni solide **interstiziali** (con nonmetalli) o composti non-stechiometrici

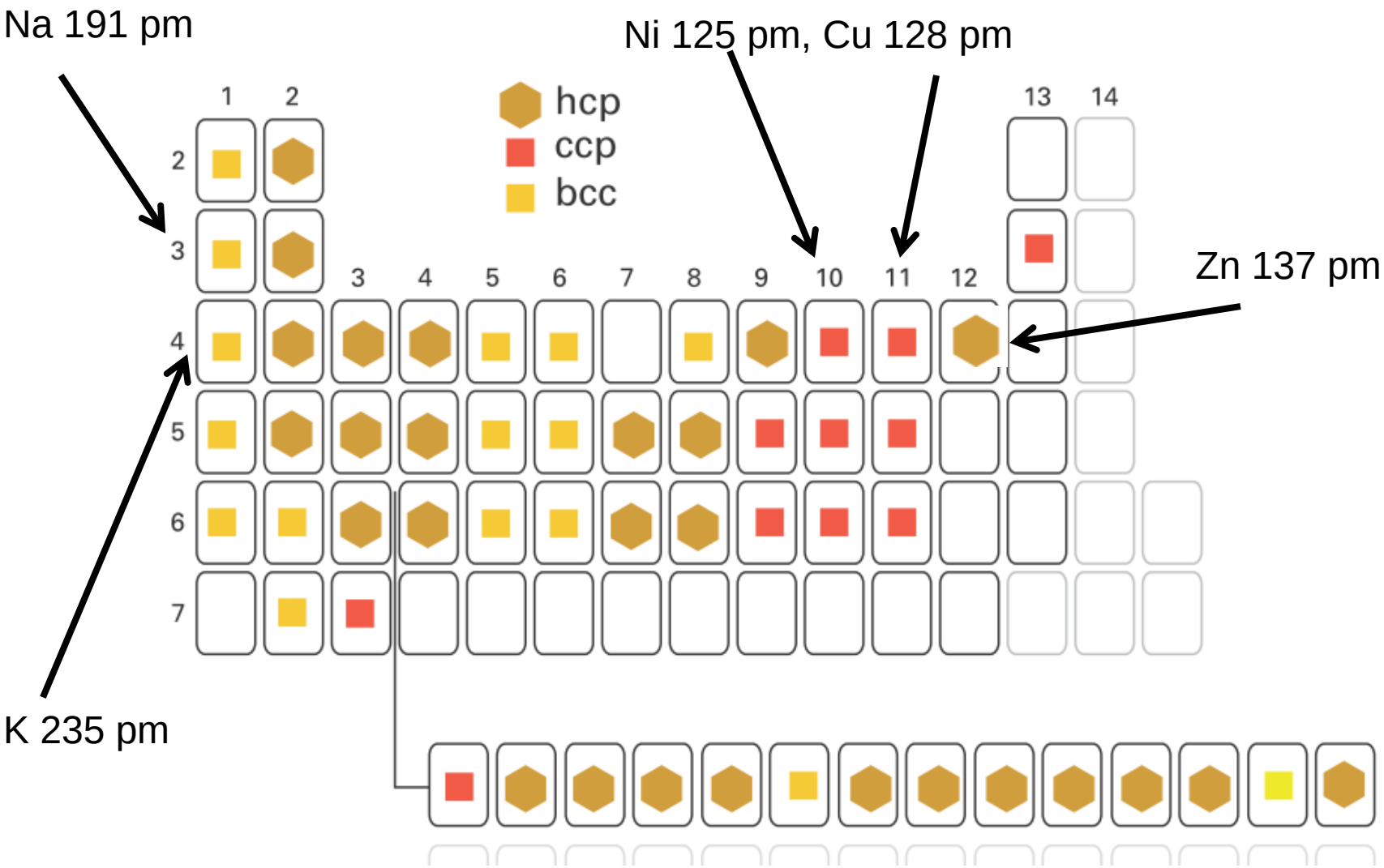
$r < 0.414R$

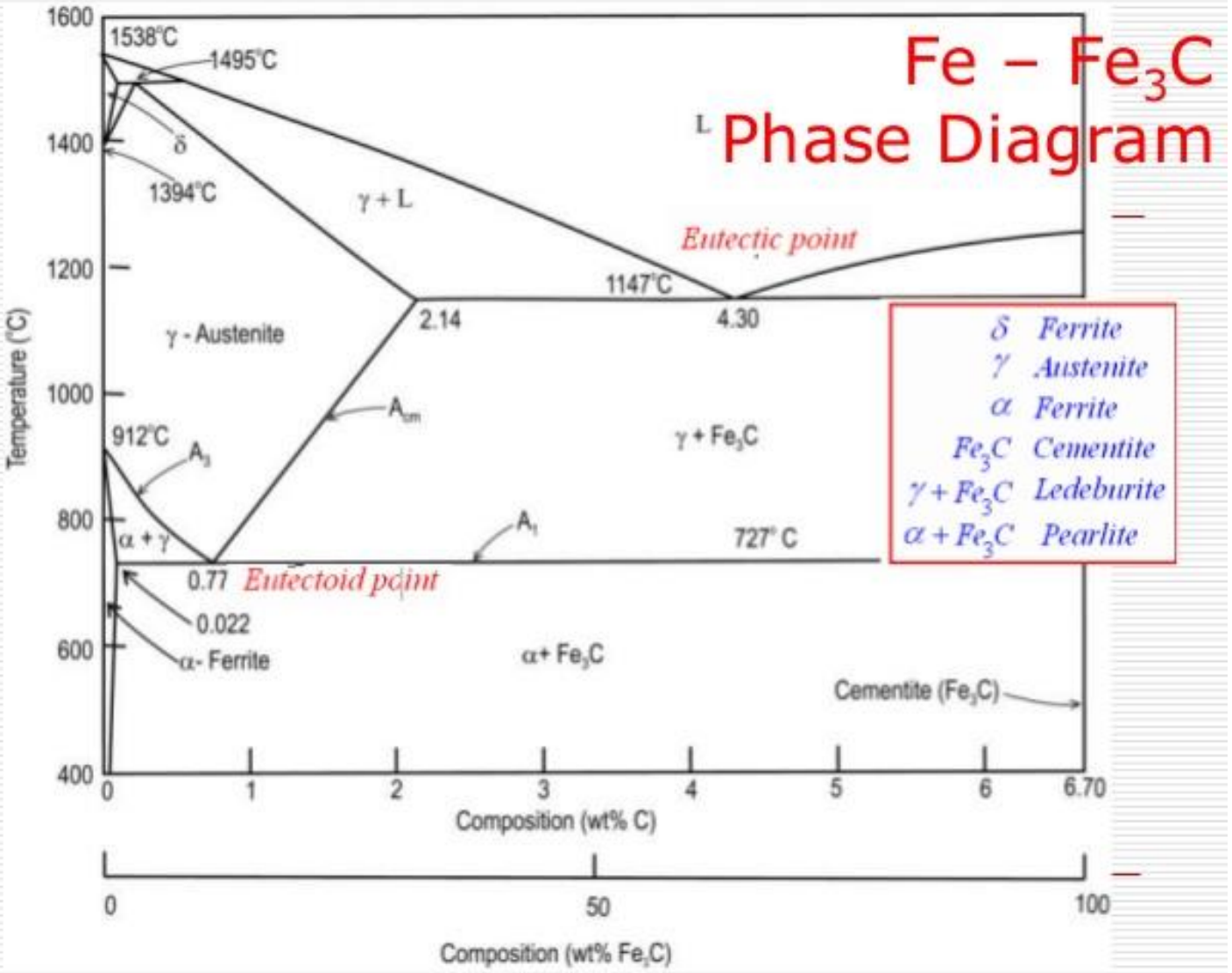
e.g. Fe/C (acciai al carbonio)

Composti interstiziali

$r < 0.414R$

e.g. WC

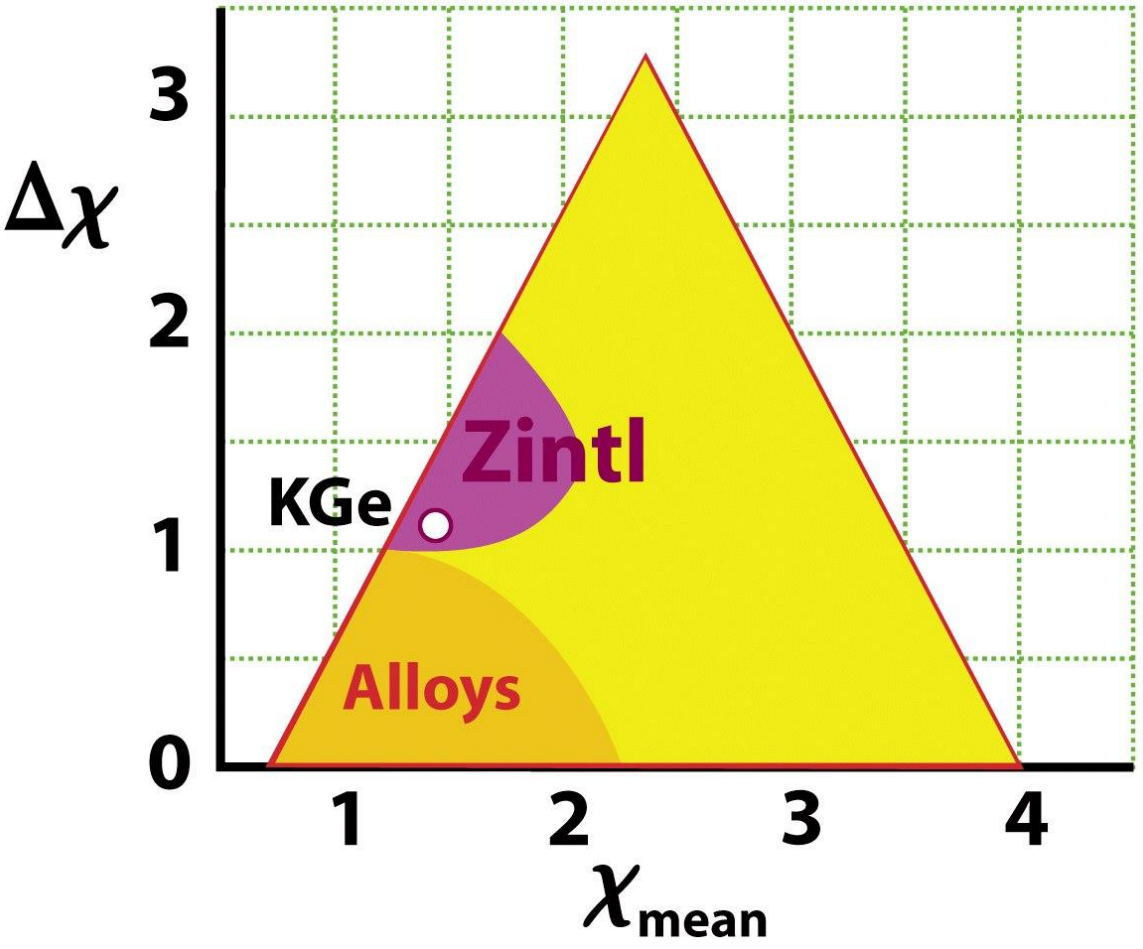

Na 191 pm
Ni 125 pm, Cu 128 pm
Zn 137 pm
K 235 pm
hcp
ccp
bcc
1
2
13
14
2
3
3
4
5
6
7
8
9
10
11
12
4
5
6
7


Fe – Fe3C
L Phase Diagram
1600
1538°C
1495°C
δ
1400
1394°C
γ + L
Eutectic point
1200
1147°C
γ - Austenite
2.14
4.30
Temperature (°C)
1000
Acm
912°C
A3
γ + Fe3C
800
α + γ
A1
727° C
0.77 Eutectoid point
0.022
600
α- Ferrite
α+ Fe3C
Cementite (Fe3C)
400
0
1
2
3
4
5
6
6.70
Composition (wt% C)
0
50
100
Composition (wt% Fe3C)
δ Ferrite
γ Austenite
α Ferrite
Fe3C Cementite
γ + Fe3C Ledeburite
α + Fe3C Pearlite

Composti intermetallici e *fasi di Zintl*

ottone-β (CuZn), alnico, $LaNi_5$, Nitinol, $MgZn_2$, Cu_3Au, NaTl, Na_5Zn_{21}

La struttura è diversa da quella di entrambi i componenti metallici



Struttura della *fase di Zintl* K_4Ge_4