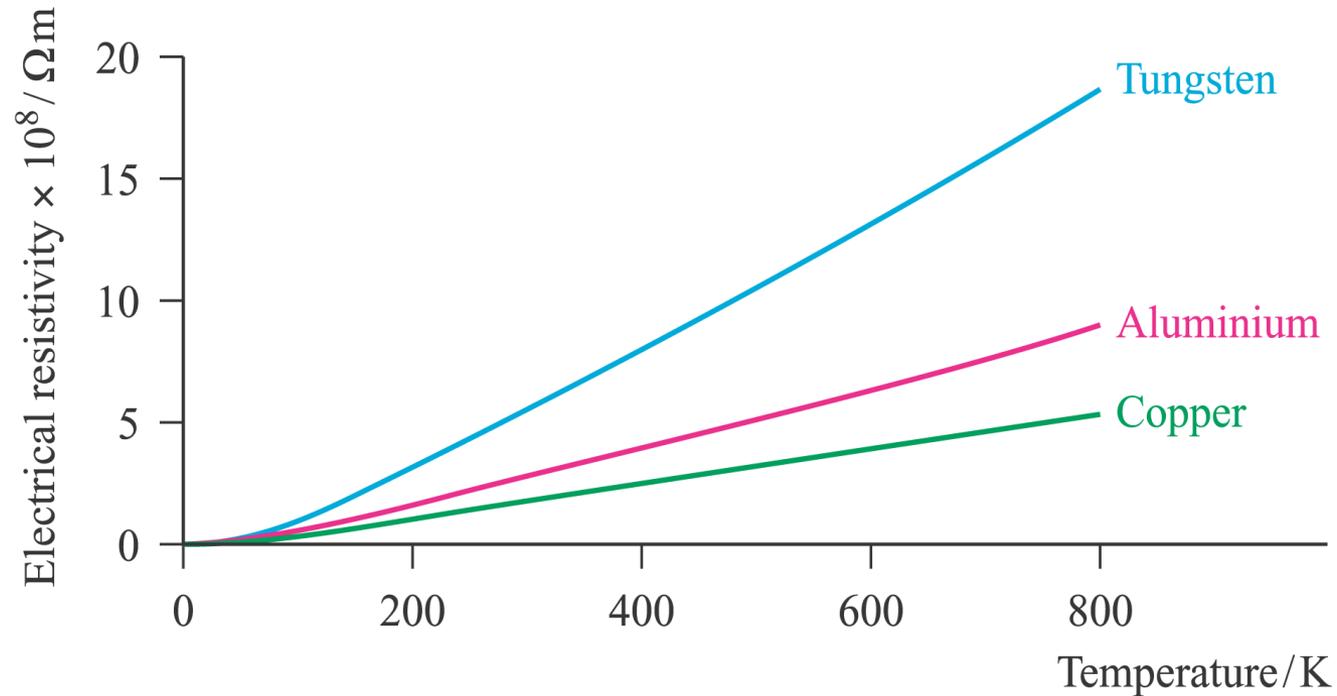
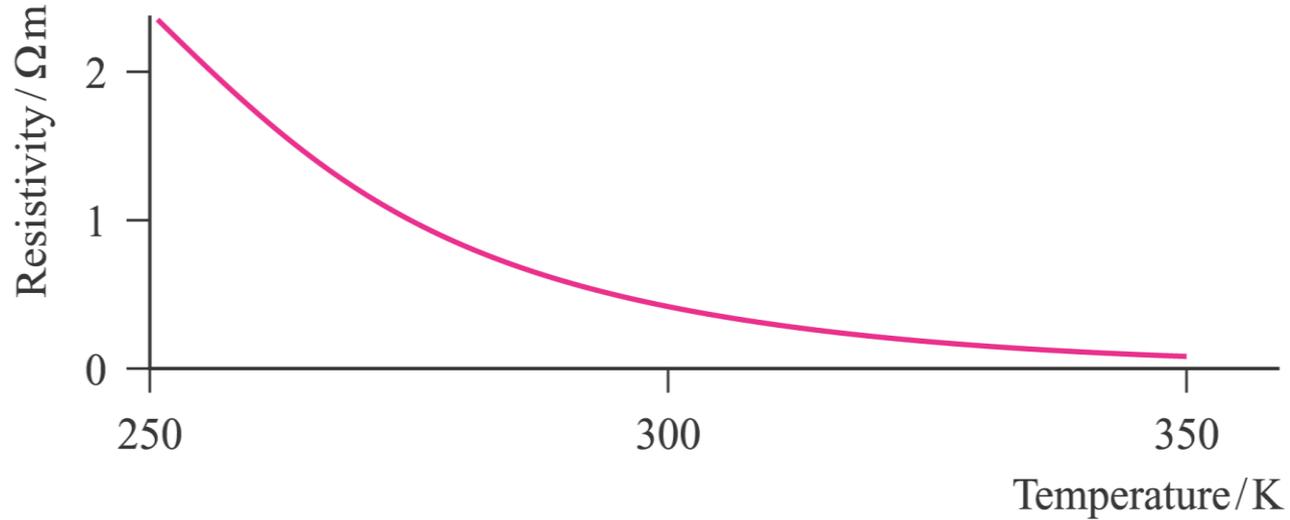


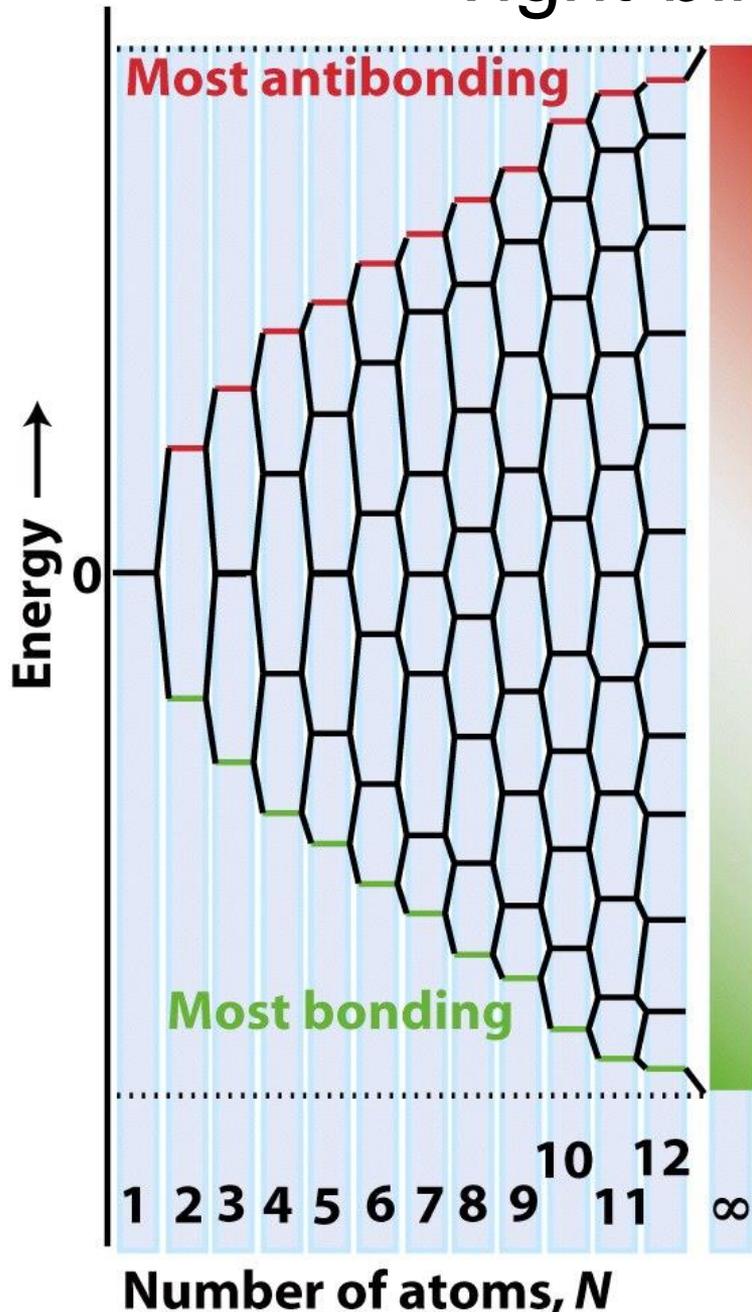
Resistività di alcuni metalli in funzione della temperatura



Resistività del semiconduttore Ge in funzione della temperatura



Tight-binding approximation

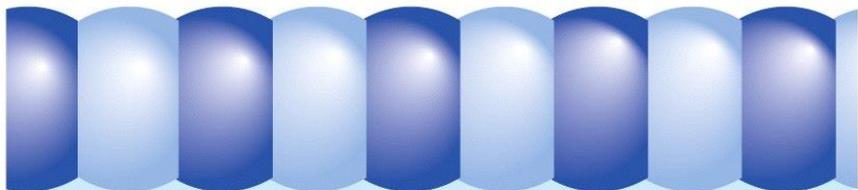


L'ampiezza complessiva della banda rimane **finita** anche se N si approssima all'infinito

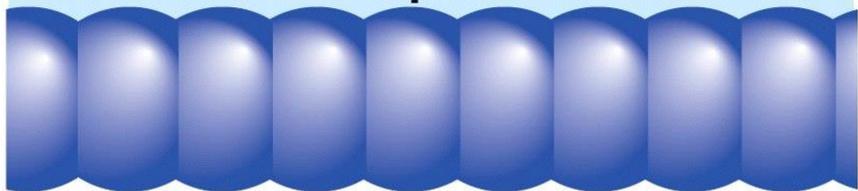
Maggiore è il grado di sovrapposizione tra orbitali atomici adiacenti e più grande è l'ampiezza della banda

Banda s

Most antibonding



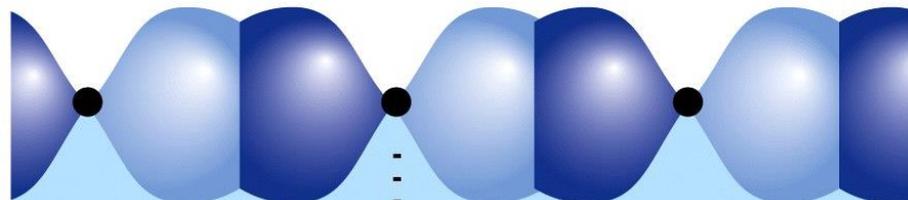
Intermediate orbitals



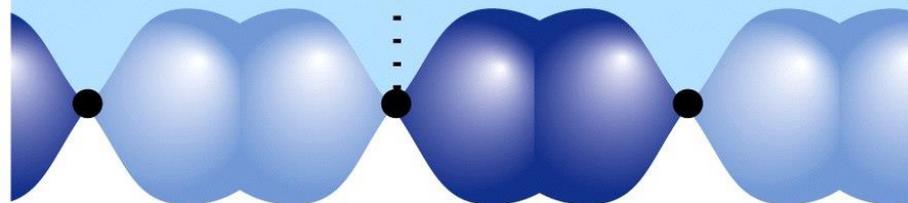
Most bonding

Banda p

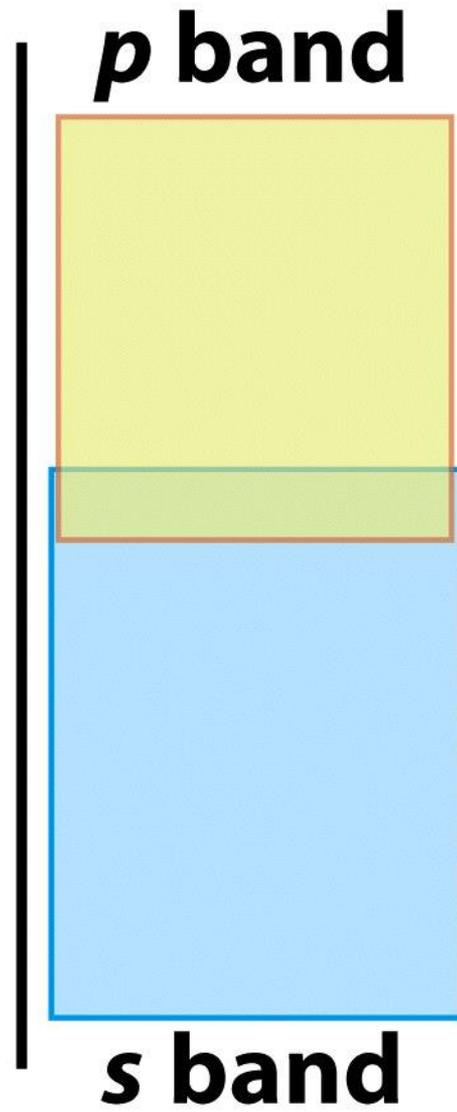
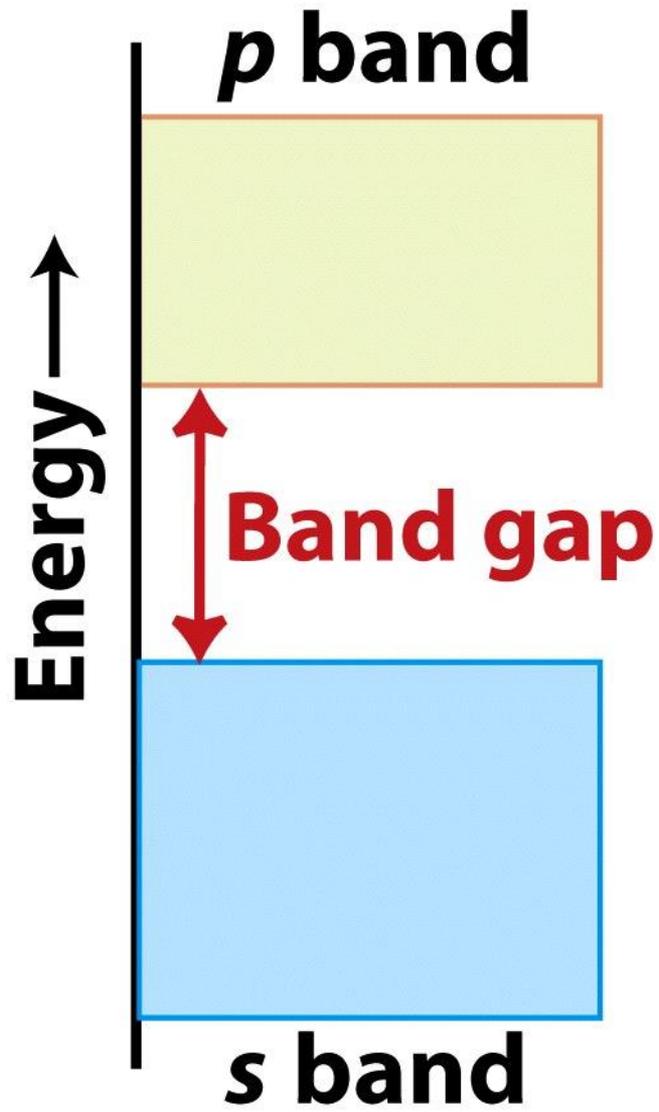
Most antibonding



Intermediate orbitals

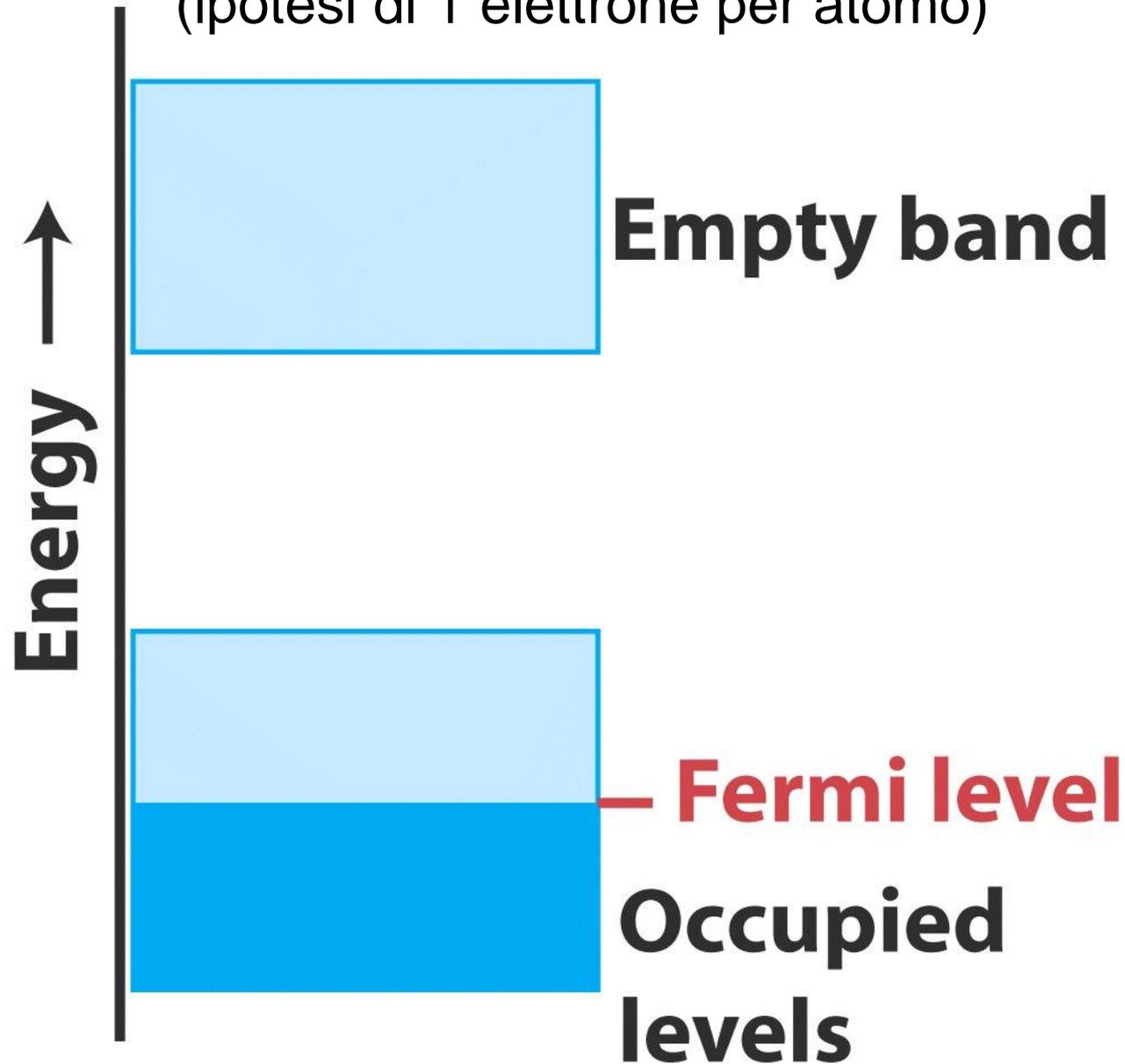


Most bonding

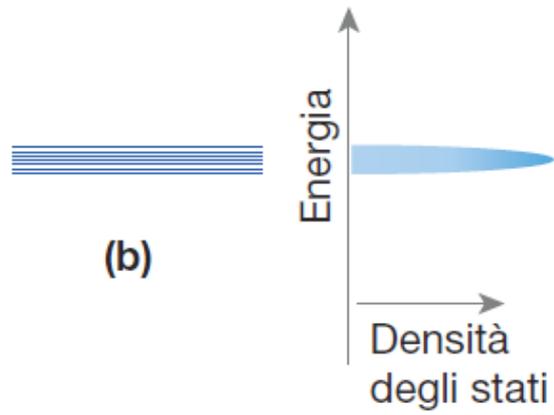
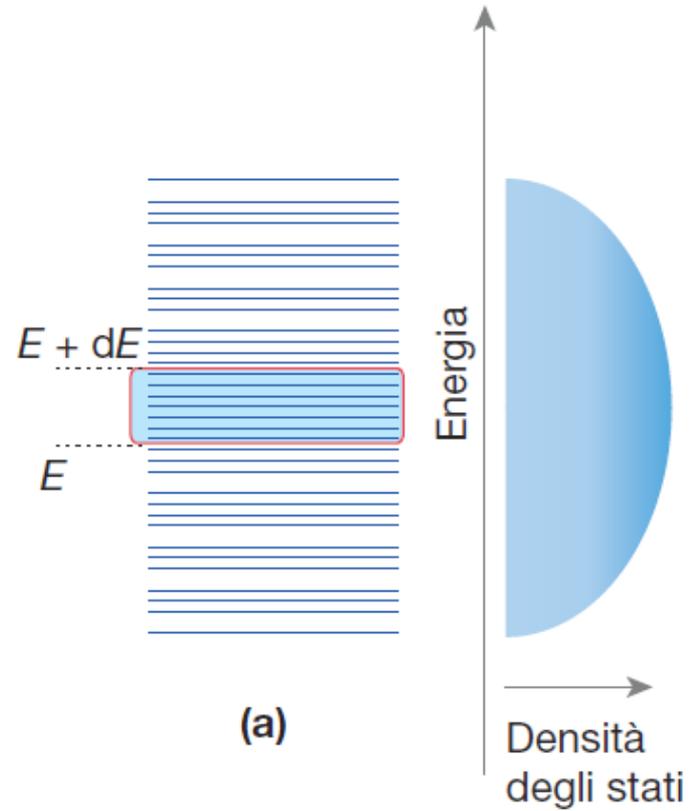


Solido conduttore metallico

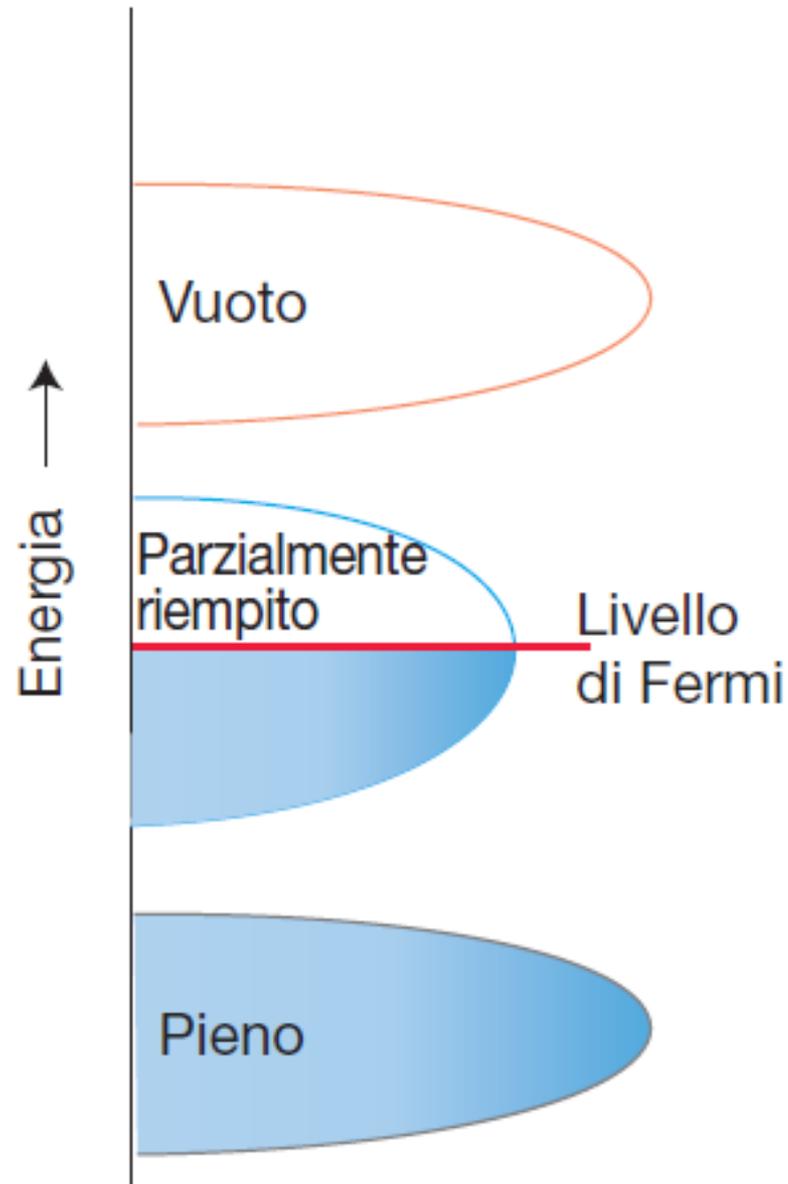
(ipotesi di 1 elettrone per atomo)



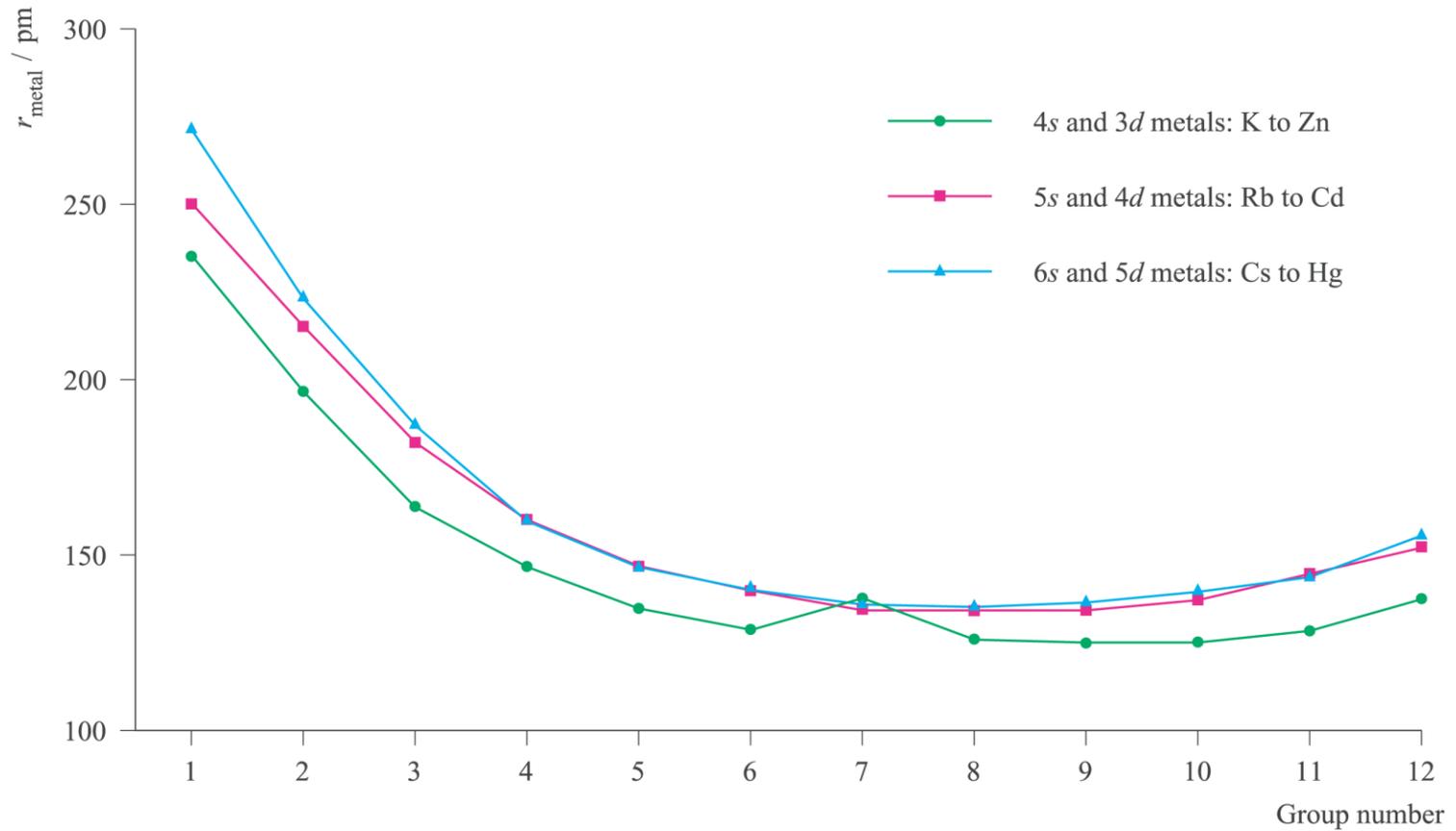
Densità degli stati elettronici



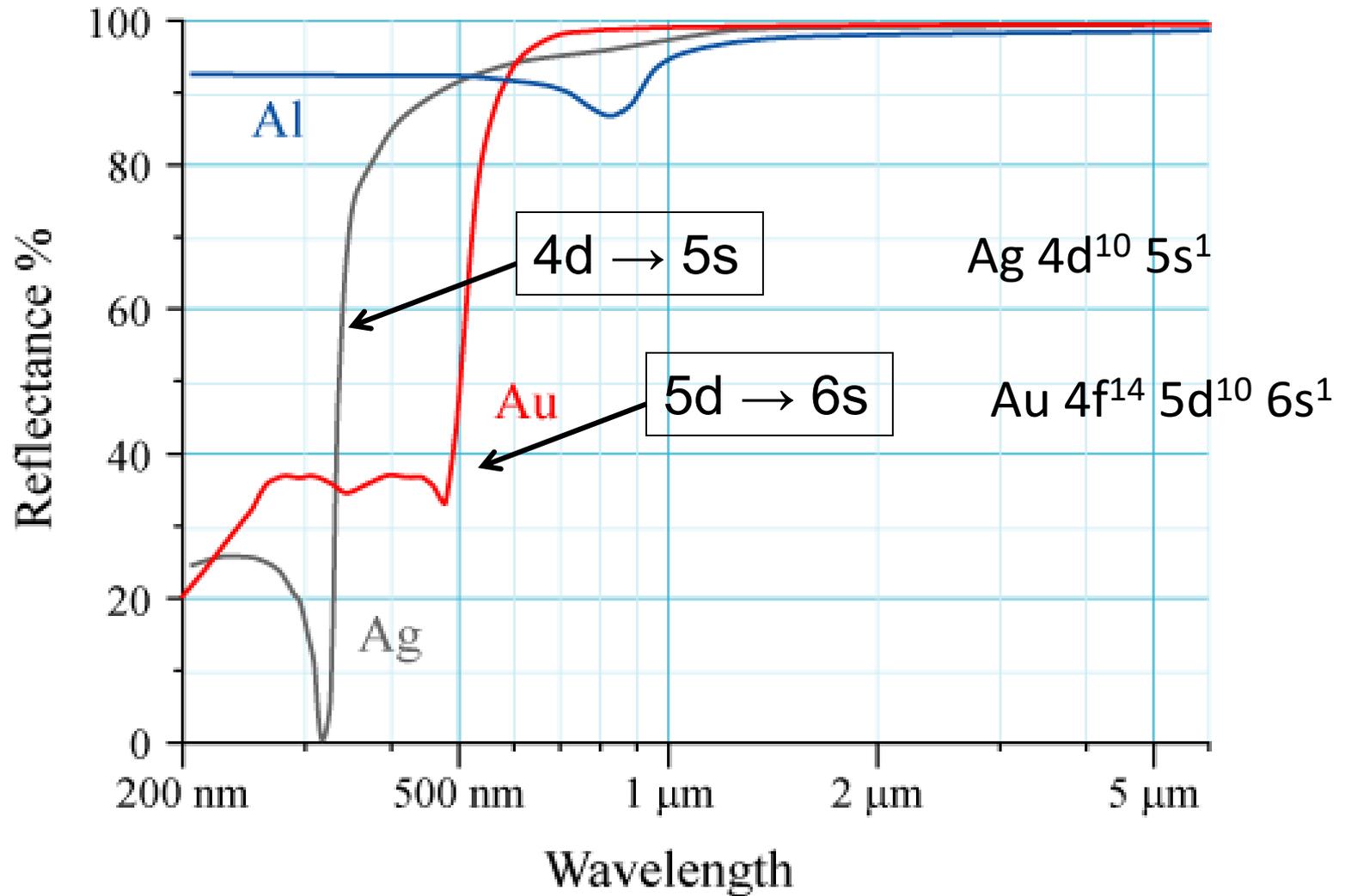
Tipiche densità di stati in un metallo



Raggio metallico



Effetti relativistici e colore dell'oro

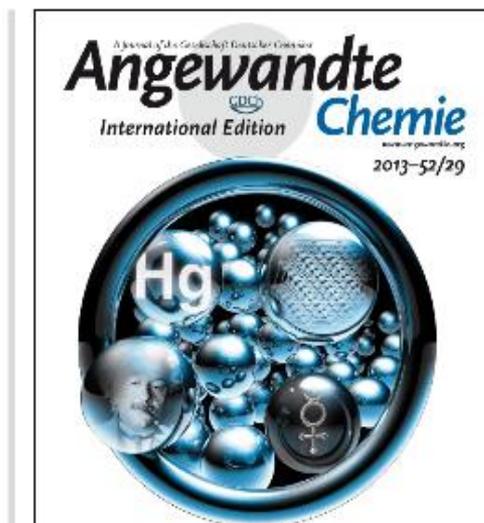


Perché il mercurio è liquido

Cover Picture: Evidence for Low-Temperature Melting of Mercury owing to Relativity (Angew. Chem. Int. Ed. 29/2013)

Dr. Florent Calvo, Dr. Elke Pahl, Dr. Michael Wormit, Prof. Dr. Peter Schwerdtfeger

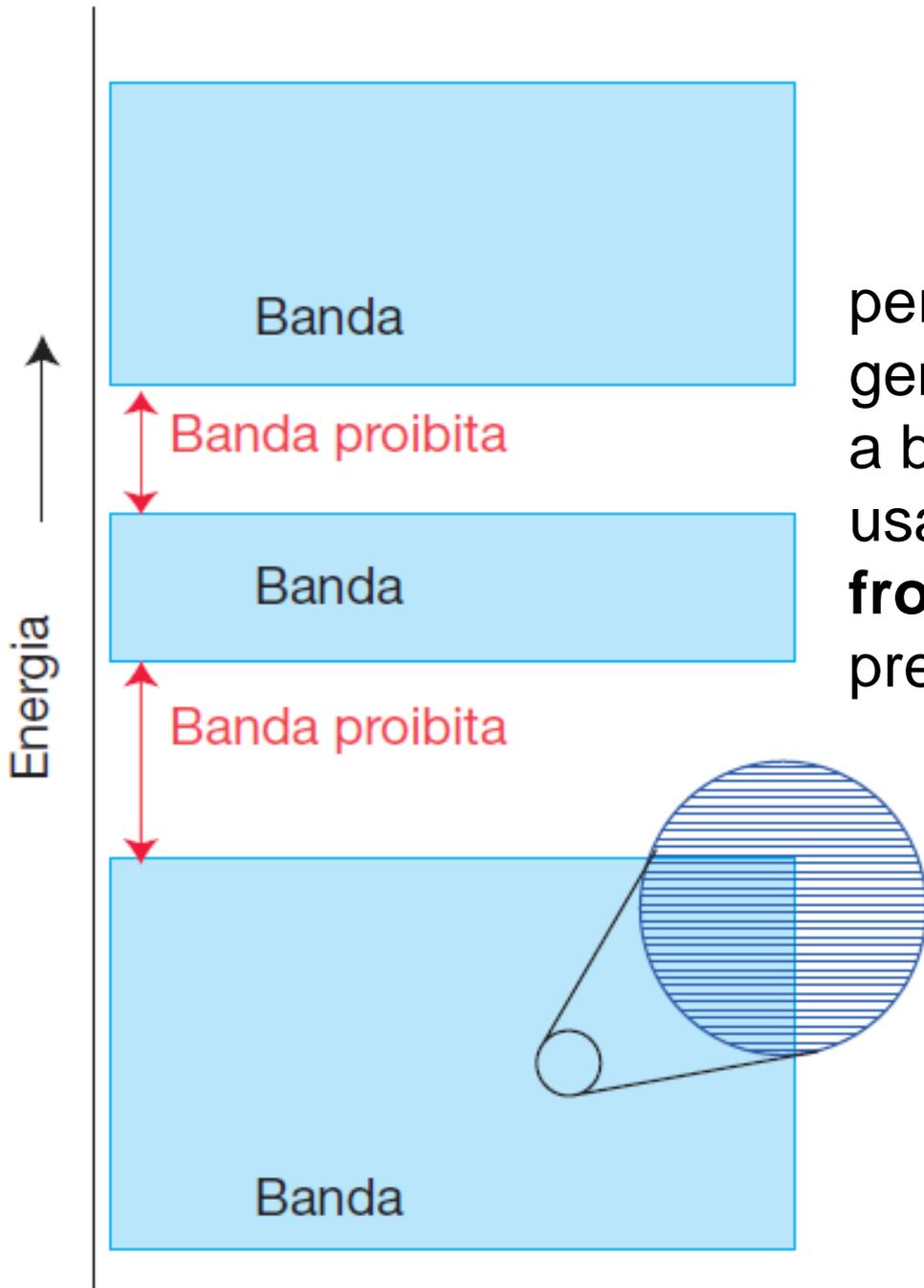
Pages: 7323 | First Published: 21 June 2013



The generalized theory of relativity gives a correct explanation of the residual motion of the perihelion of planet mercury. As F. Calvo, P. Schwerdtfeger, et al. show in their Communication on page 7583 ff., the special theory of relativity has furnished an even more remarkable result. It gives the correct explanation as to why mercury is the only liquid metal at room temperature, as demonstrated by parallel-tempering Monte Carlo simulations (Picture: Cameron Smorenburg).

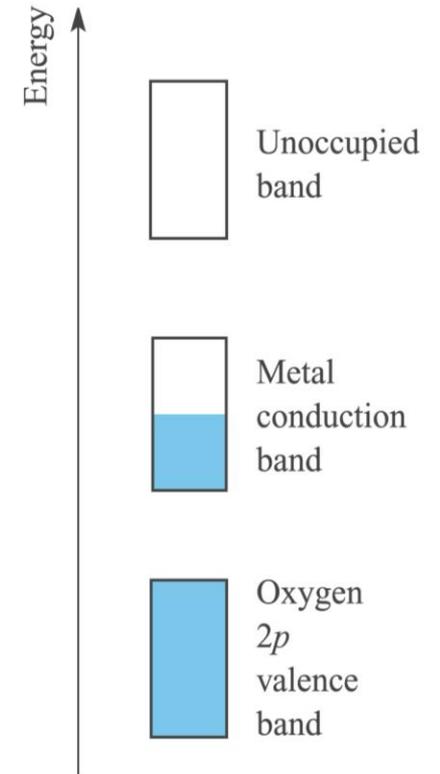
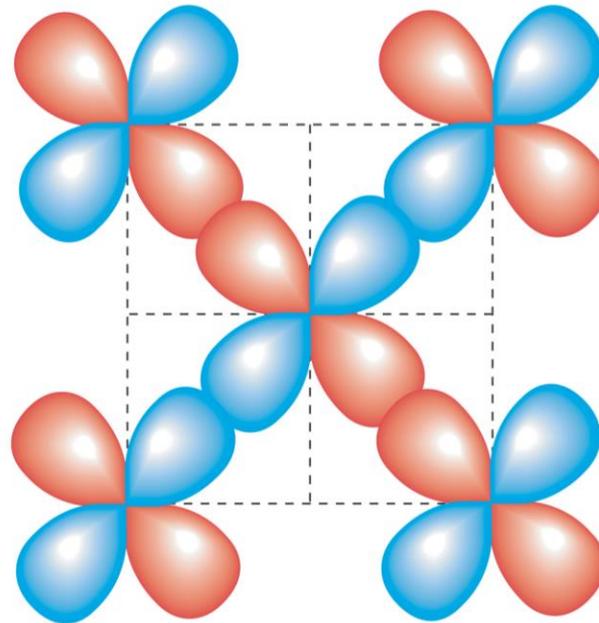
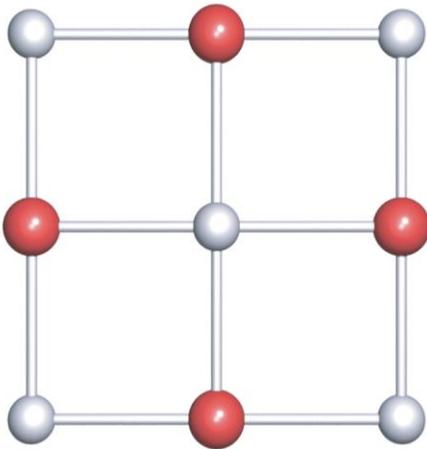
<https://www.youtube.com/watch?v=NtnsHtYYKf0>

L. J. Norrby Why is mercury liquid *J. Chem. Ed.* **1991**, *68*, 110.

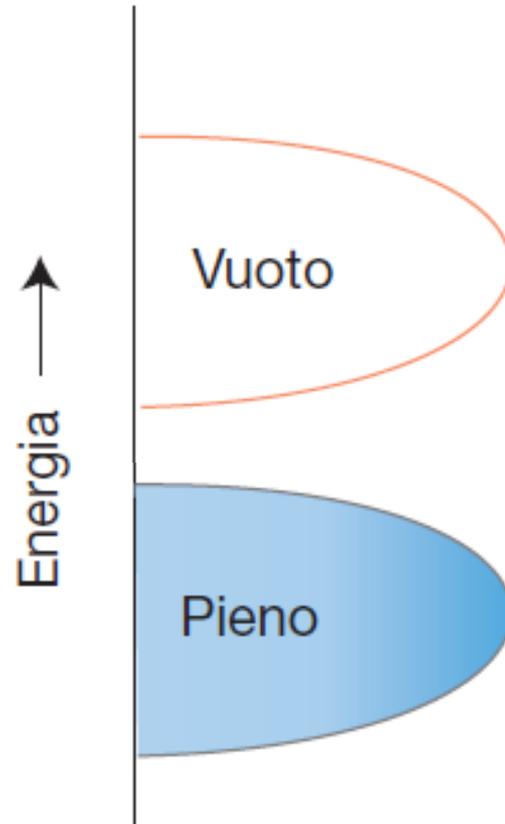


per qualsiasi solido si può generare un diagramma a bande, che viene costruito usando gli **orbitali di frontiera** di tutti gli atomi presenti.

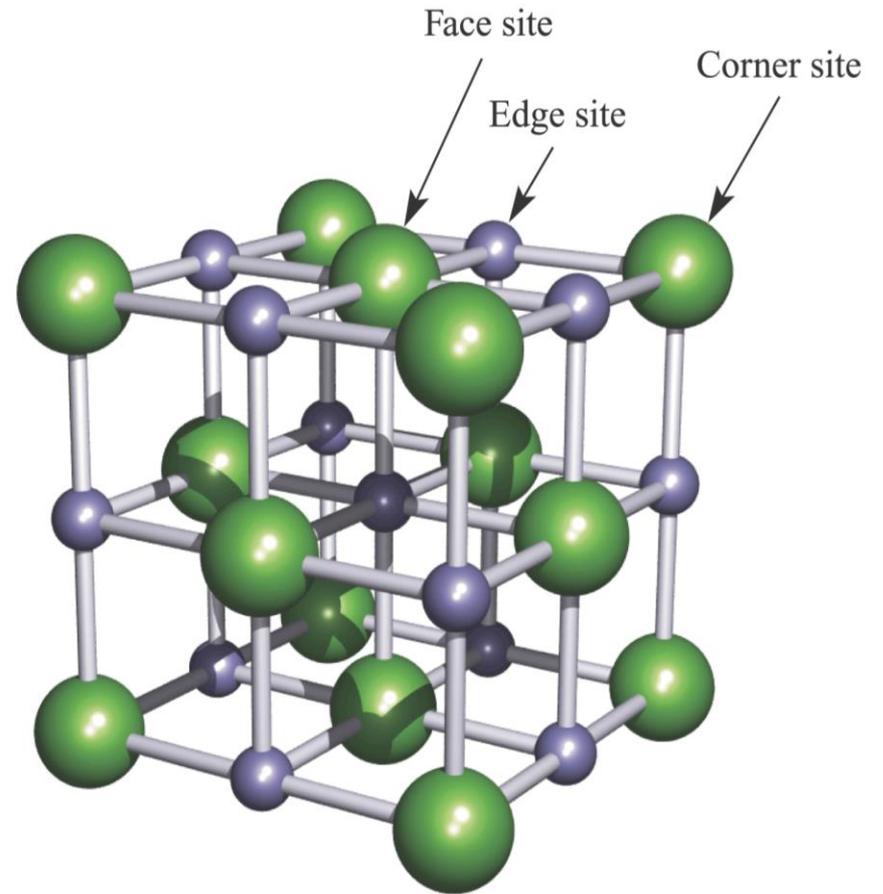
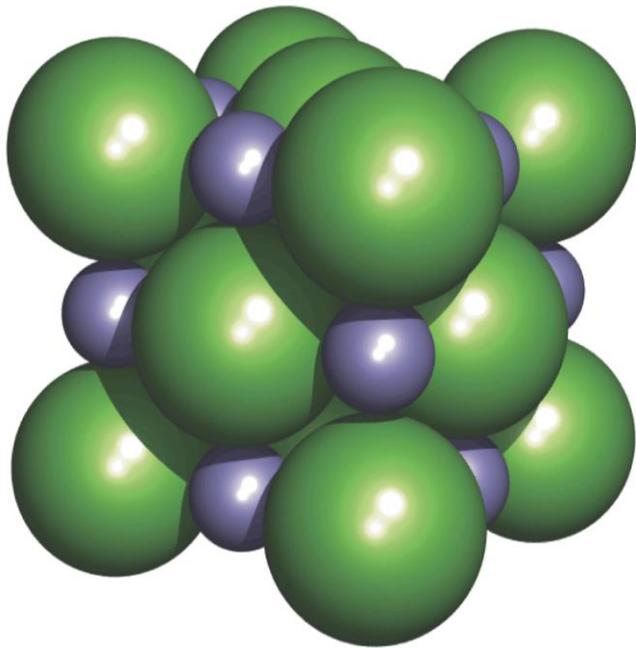
TiO, un ossido metallico conduttore



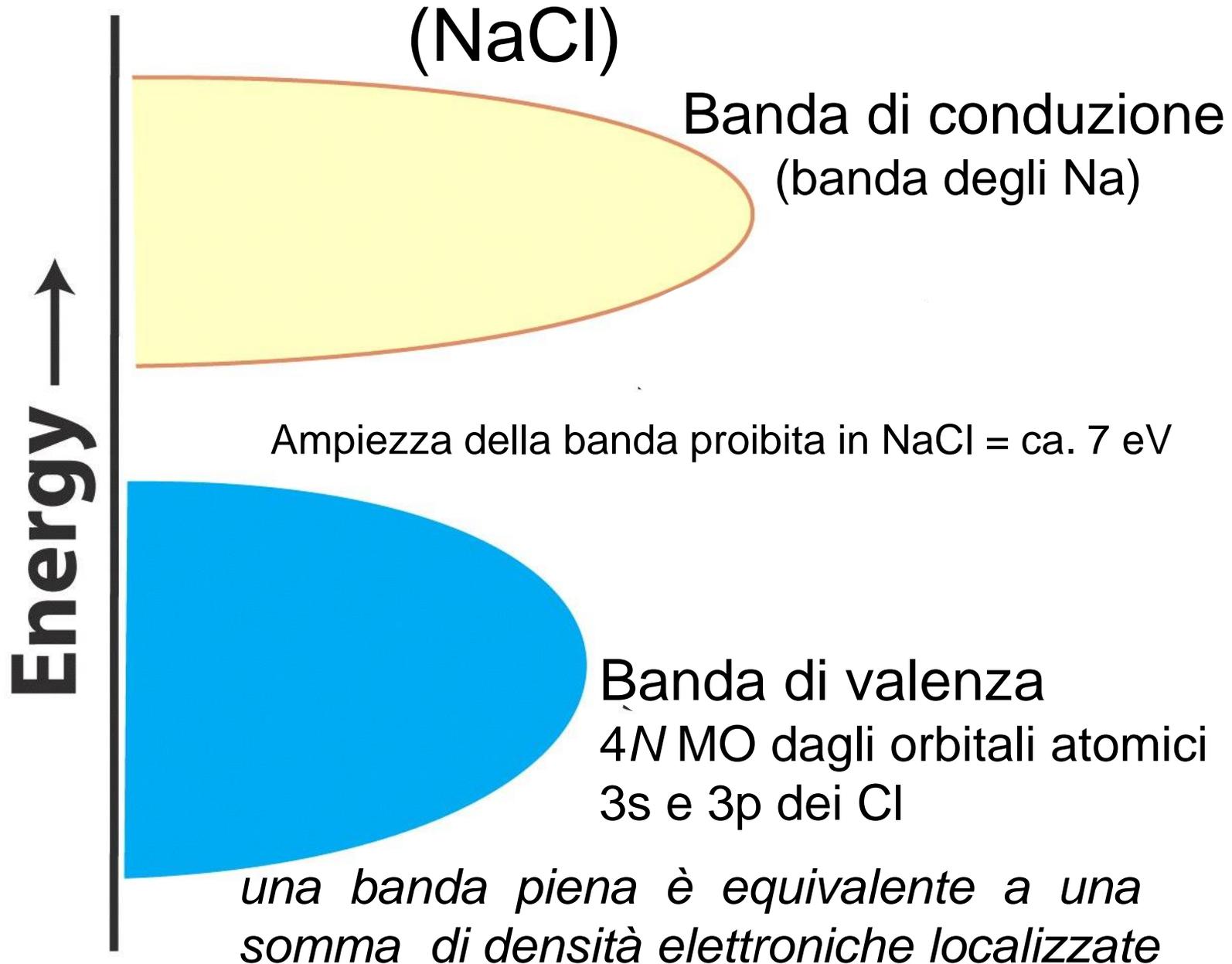
Tipiche densità di stati in un semiconduttore/isolante



NaCl



Tipiche densità di stati in un isolante



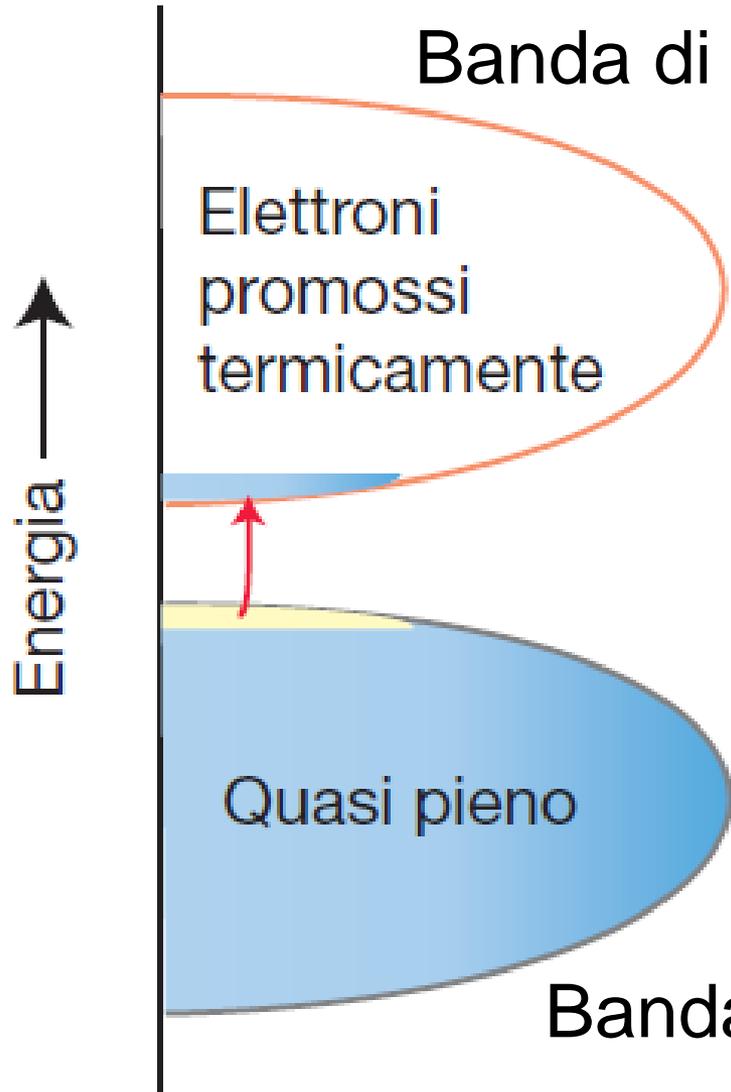
Alcune ampiezze di bande proibite

Materiali	E_g /eV
Carbone (diamante)	5,47
Carburo di silicio	3,00
Silicio	1,11
Germanio	0,66
Arseniuro di gallio	1,35
Arseniuro di indio	0,36

La linea di divisione tra isolanti e semiconduttori dipende dalle dimensioni della banda proibita e dalla temperatura

Semiconduttore intrinseco

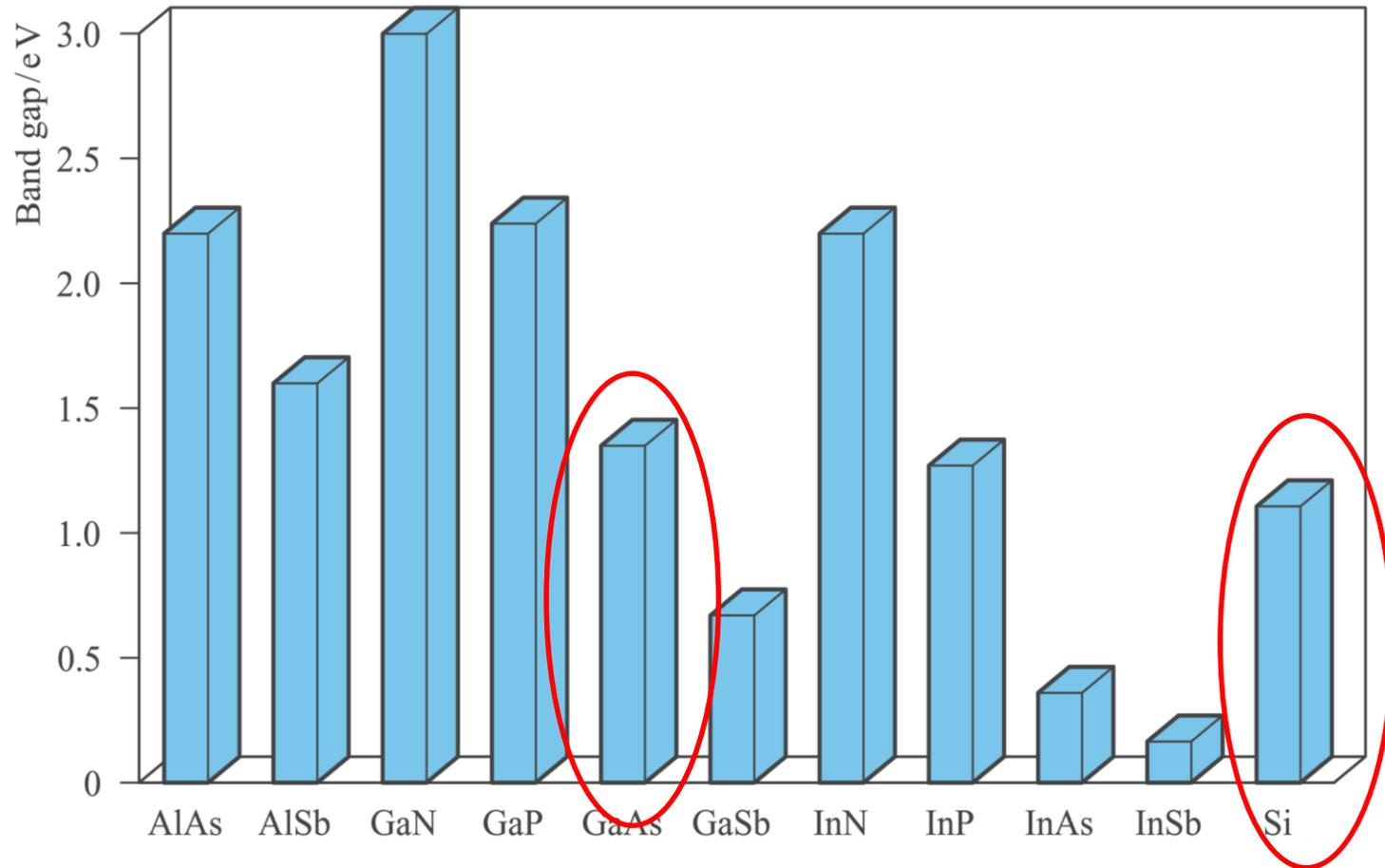
andamento di tipo Arrhenius della conducibilità con la temperatura



$$\sigma = \sigma_0 e^{-E_g/2kT}$$

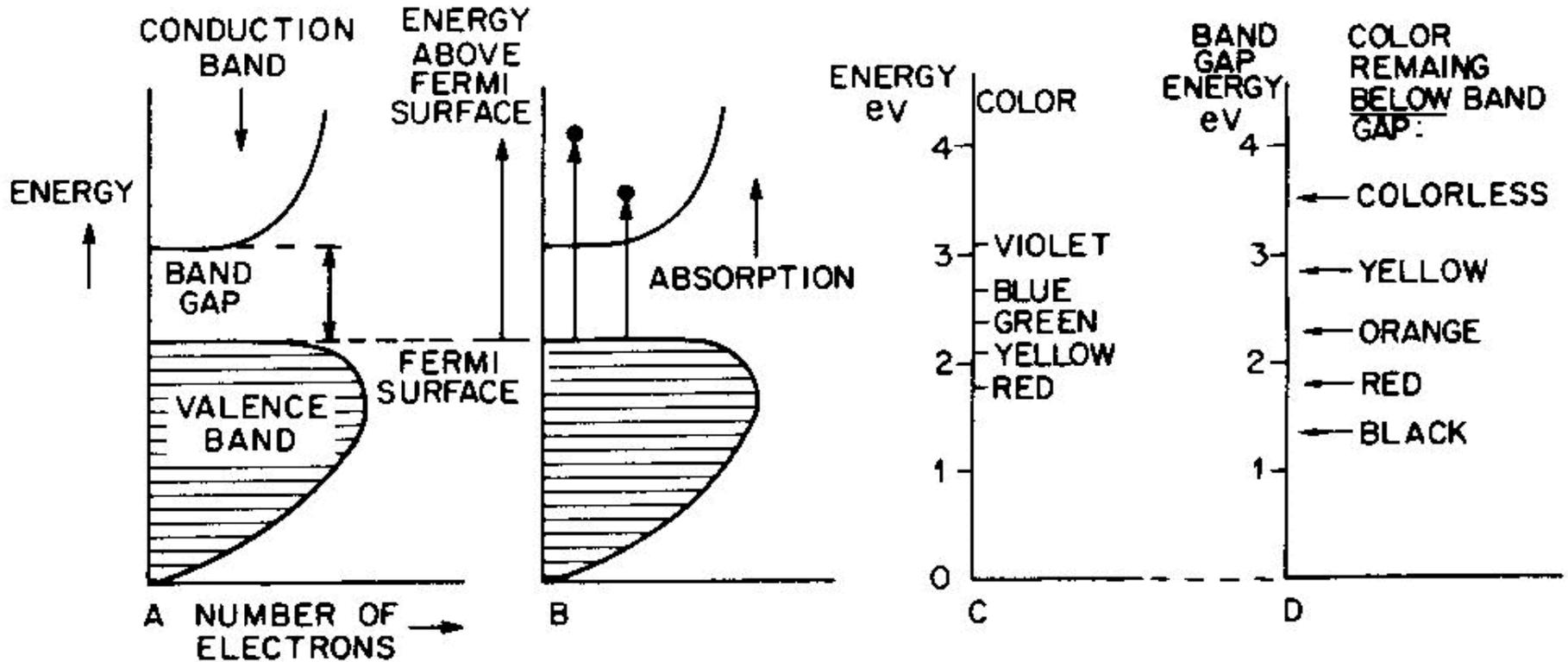
sia le lacune che gli elettroni promossi sono liberi di muoversi e conducono la corrente elettrica

Bande proibite in **semiconduttori III – V** (o 13 – 15) vs silicio

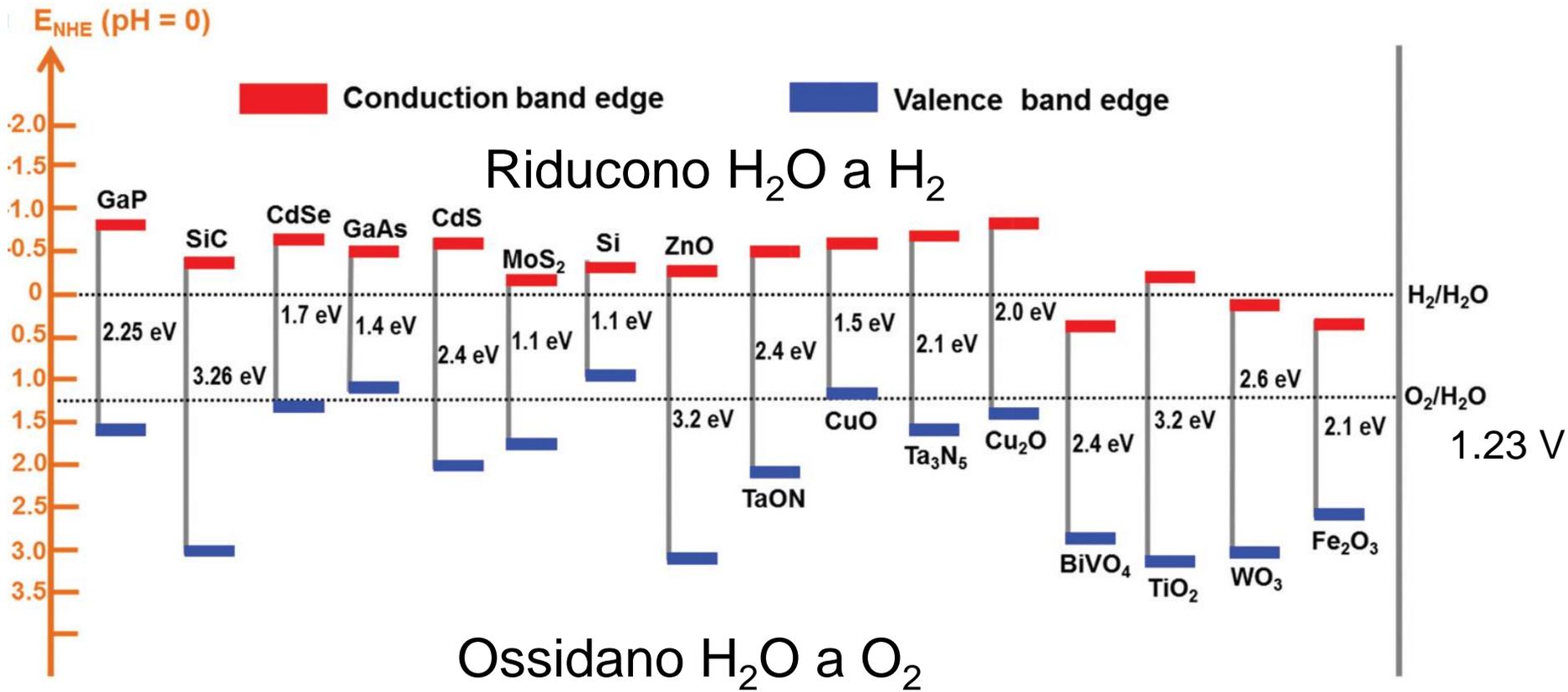


L'arseniuro di gallio ha una maggiore mobilità elettronica rispetto al silicio

La promozione di elettroni dalla banda proibita a quella di valenza può essere indotta dalla luce



e.g. la galena, PbS , è grigio-nera poiché il band gap è solo 0.4 eV, cioè assorbe tutto l'intervallo della luce visibile.



Luce emessa dai LED (*light emitting diodes*) in funzione della composizione

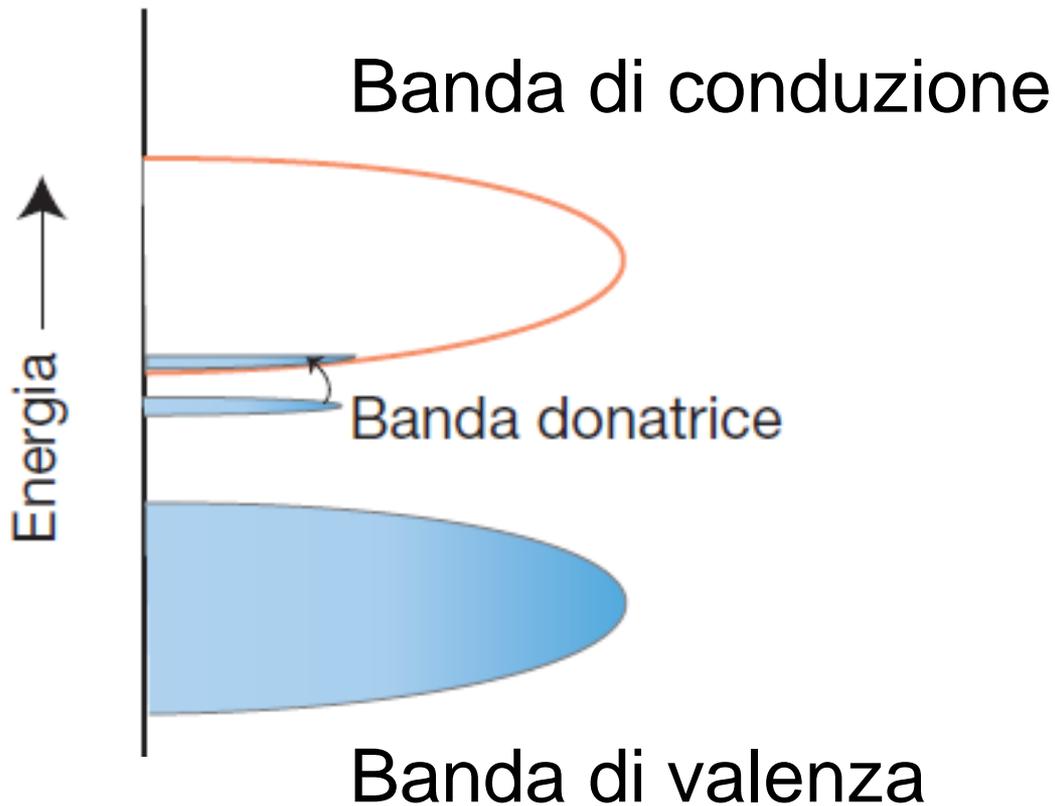
x in $\text{GaAs}_{1-x}\text{P}_x$	Substrate	λ / nm	Observed colour or region of spectrum
0.10	GaAs	780	Infrared
0.39	GaAs	660	Red
0.55	GaP	650	Red
0.65	GaP	630	Orange
0.75	GaP	610	Orange
0.85	GaP	590	Yellow

Semiconduttori estrinseci

(drogaggio sostitutivo)

Tipo n

e.g. Si drogato con As



Tipo p

e.g. Si drogato con Ga

