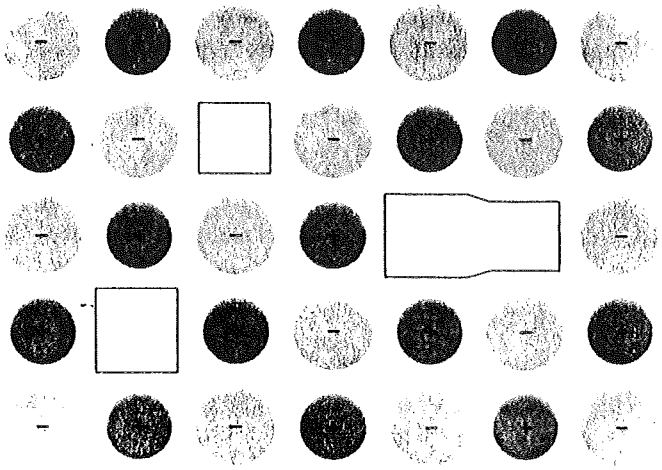


**Figura 1** Un piano di un cristallo puro di alogenuro alcalino con un posto da ione positivo vacante, un posto da ione negativo vacante e una coppia di posti vacanti da ioni di segno opposto vicini.

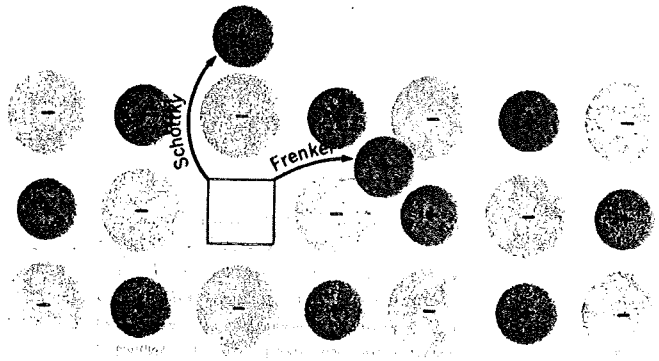



**Figura 3** Difetti Schottky e difetti Frenkel in un cristallo ionico. Le frecce indicano lo spostamento degli ioni. In un difetto Schottky lo ione è portato in superficie, in un difetto Frenkel lo ione è portato in una posizione interstiziale.

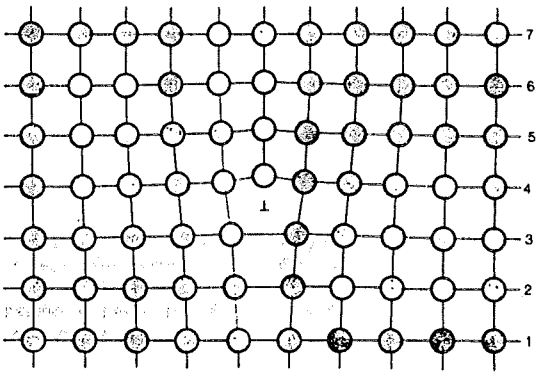



Fig. 2.20 - Dislocazione a spigolo (« *edge dislocation* »). La dislocazione è normale al piano della pagina e passa per il punto indicato col segno ⊥.

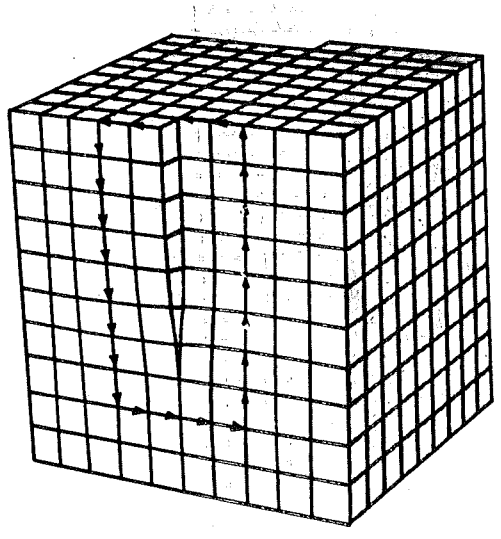


Fig. 2.22 - Dislocazione a vite (« *screw dislocation* »).

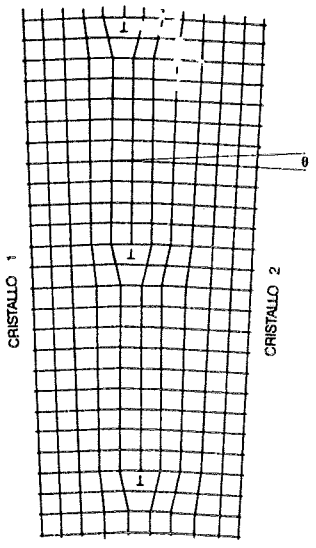



Fig. 2.23 - Bordi di grano (« *grain boundaries* ») di piccolo angolo. θ è la differenza di orientazione tra i due grani.

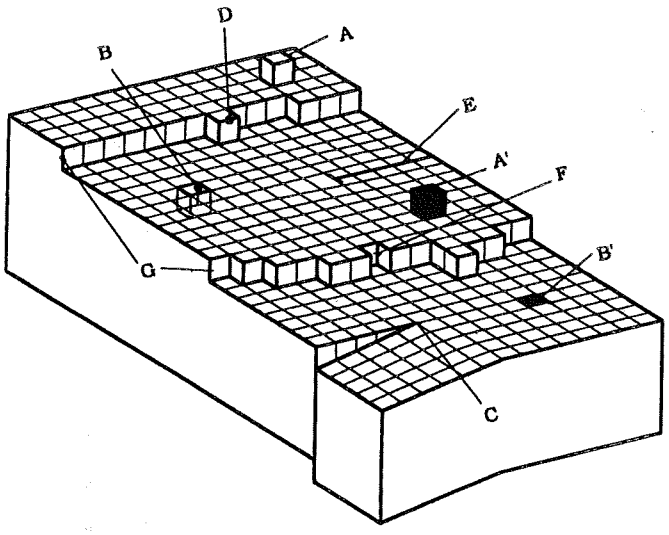



Fig. 1.20. Some types of surface defects.

DIFETTI CHE INDUCONO STATI NELLA GAP

AMORFI →

↓

DANGLING BONDS

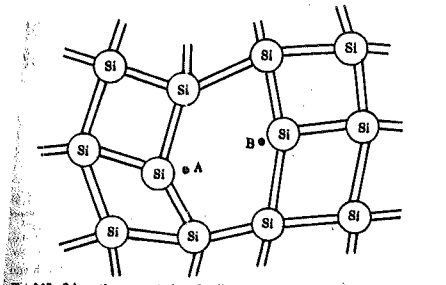



Fig. 3.17. Schematic representation of a disordered lattice of amorphous silicon. Most of the atoms establish four bonds, but because of the deformations situations exist in which atoms A and B are too far apart to establish a bond.

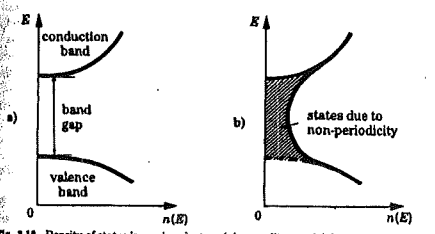



Fig. 3.18. Density of states in semiconductors (a) crystalline, and (b) amorphous, of the same chemical composition.

SUPERFICI →

↓

DANGLING BONDS

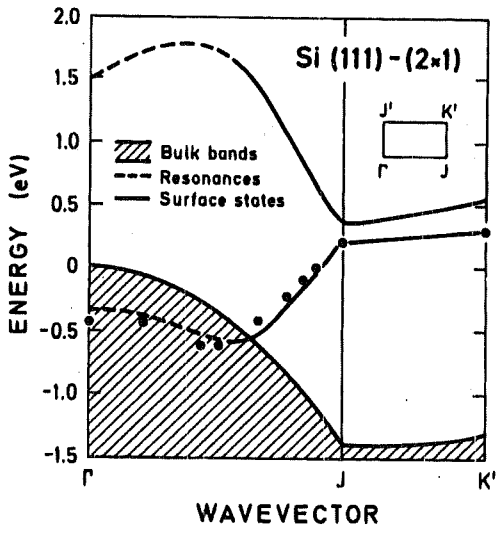



**Fig.6.33.** Dispersion of the dangling-bond surface-state bands for the Si(111)-(2 × 1) surface together with the projected bulk-band structure (*shaded*). The corresponding symmetry directions in k-space are explained in the inset (surface Brillouin zone). Full and broken curves are the results of theoretical calculations [6.37]. Data points were obtained by ARUPS measurements [6.38]

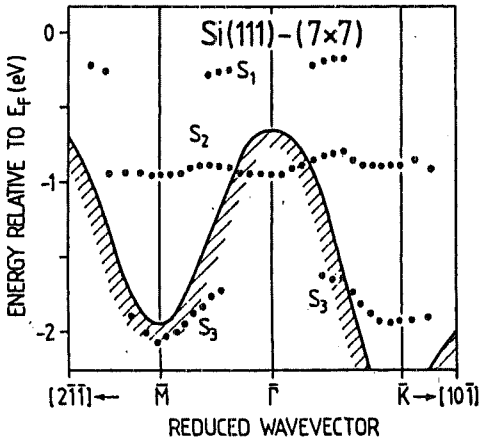



**Fig.6.38.** Experimentally determined dispersion of surface state bands ($S_1$, $S_2$, $S_3$) on the clean Si (111) -(7 × 7) surface (*points*). The projected bulk valence band is indicated by its shaded upper boundary [6.47]

# IMPUREZZE

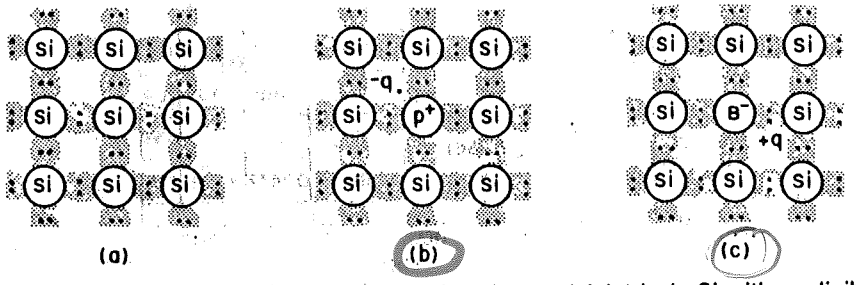



**Fig. 9** Three basic bond pictures of a semiconductor. (a) Intrinsic Si with negligible impurities. (*b*) *n*-type Si with donor (phosphorus). (c) *p*-type Si with acceptor (boron).

## DONORI

Nel Si : atomi di valenza 5

P $3s^2 3p^3$

As $4s^2 4p^3$

extra elettrone facilmente ionizzato

DROGAGGIO n-type

## ACCETTORI

Nel Si : atomi di valenza 3

B $2s^2 2p^1$

Al $3s^2 3p^1$

Ga $4s^2 4p^1$

DROGAGGIO p-type

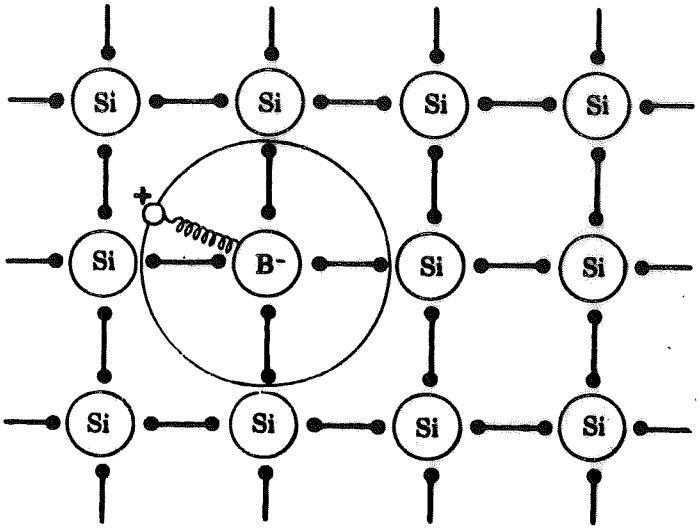



**Fig. 3.6.** Boron atom in a substitutional position in a silicon lattice. At low temperature the hole is bound to the boron nucleus in an orbit which covers many atomic sites. At high temperature the hole is released into the valence band; boron is an acceptor.

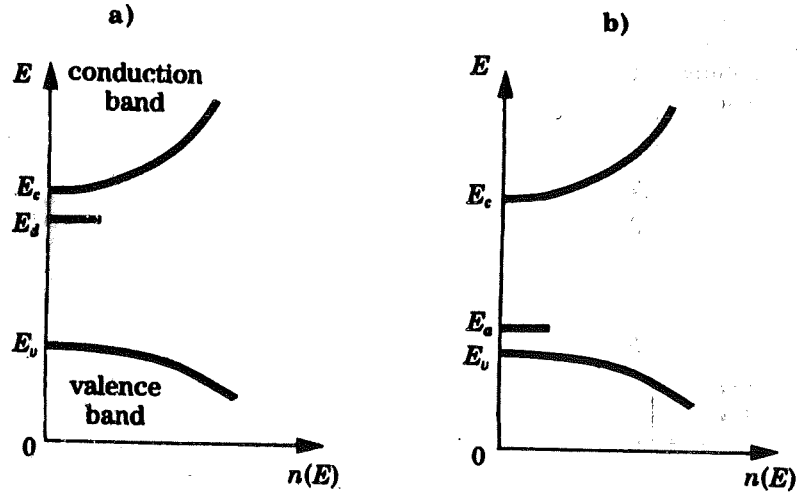
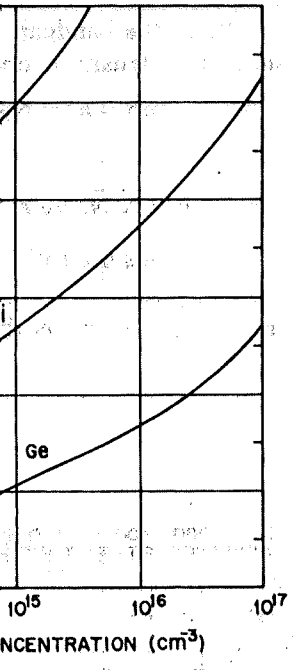



**Fig. 3.7.** Density of states curve in the vicinity of the band gap in the presence of (a) donors, (b) acceptors.




function of background concentration.

Ge, Si, and GaAs.[20,23] As expected, the intrinsic carrier density will be. carrier density is small compared to increases rapidly with temperature, igh temperatures, therefore, thermal of carrier generation. Because of this on becomes equal to the background rature $T_i$. Figure 12 gives a plot of background concentration. Below $T_i$ temperature independent. Above $T_i$, mperature. The intrinsic temperature to the formation of current filament in later chapters.

with donor or acceptor impurities, d. A donor level is defined as being positive if empty. An acceptor level is by an electron.

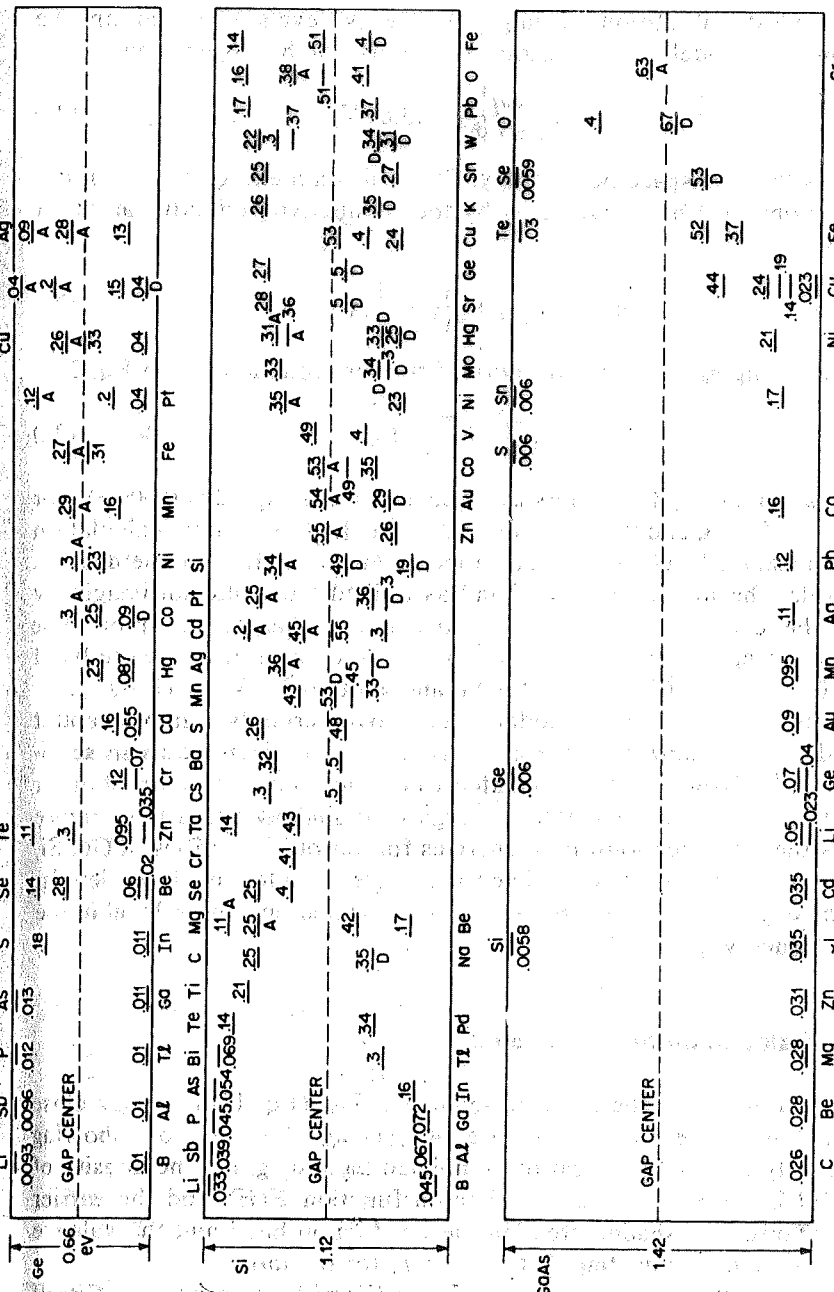



**Fig. 13** Measured ionization energies for various impurities in Ge, Si, and GaAs. The levels below the gap centers are measured from the top of the valence band and are acceptor levels unless indicated by D for donor level. The levels above the gap centers are measured from the bottom of the conduction-band level and are donor levels unless indicated by A for acceptor level. The bandgaps at 300 K are 0.66, 1.12, and 1.42 eV for Ge, Si, and GaAs, respectively. (After Conwell, Ref. 27; Sze and Irvin, Ref. 28; Milnes, Ref. 24.)