19 Classification of Solids

metals vs. insulators - partially filled bands
distribution k-space
not real space
Fig. 19.1 Ne & Sodium
Think tight binding,
but still.

Insulators: > Covalent crystals
not uniform between ions
localized preferred directions
→ bonds
digression sp^3 hybrid. & meaning of bond
example diamond (Fig. 2)
digression dancing?
and filled bands

> Molecular Crystals
noble gases: Ne, Ar, ...
extreme tight binding
very little overlap

> Ionic crystals
sodium chloride
highly local., but ions
charged hard spheres
impenetrable - Pauli excl.
& tightly bound core

Alkali Halides (I-VII ionic crystals)

Br^- Rb^+

$-3.5eV$ $4.2eV$

$-e^2/r = -4.2eV$

Narrow bands in figure

lattice constants from hard spheres

d could be determ. by larger ion alone

Pictures 19.7 → 19.9

II-VI Ionic Crystals

Doubly ionized

Most NaCl structure (list)

III-V Crystals

Mixed Ionic & Covalent

Covalent Crystals

Charge between atoms (Fig. 19.10)

Not as good insulators as ionic crystals

Molecular Crystals

Noble gases (except He)

Monatomic FCC

van der Waals or fluctuating dipole

$P_2 = \alpha E \sim \alpha \frac{p_1}{r^3}$, α = polarizability

$P_2 E \sim \frac{\alpha \overline{p_1^2}}{r^6}$

$\langle p_1^2 \rangle$ does not vanish

V-VII molecular & covalent

Metals

Paradigm: Alkali

Hydrogen-Bonded Crystals

H not like Alkali

Only 1 covalent bond

Small size

Illustration of ice (19.11)