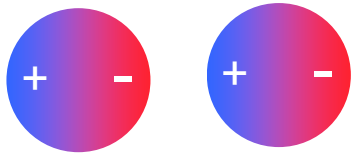
cohesive forces

- molecular crystal: closed-shell atomic/molecular structures

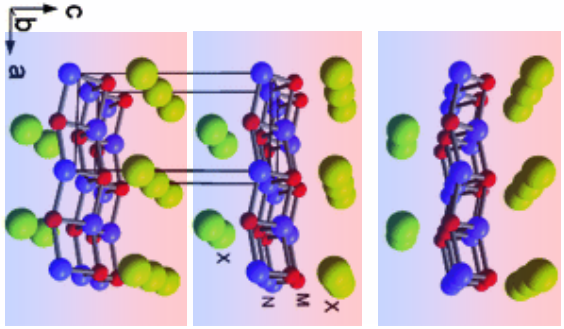
no covalent chemical binding

noble gases He, Ne, …

van der Waals force:

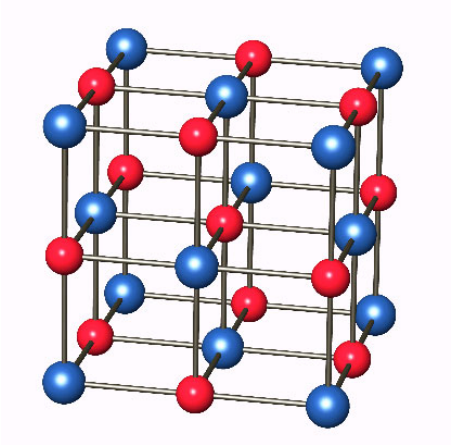


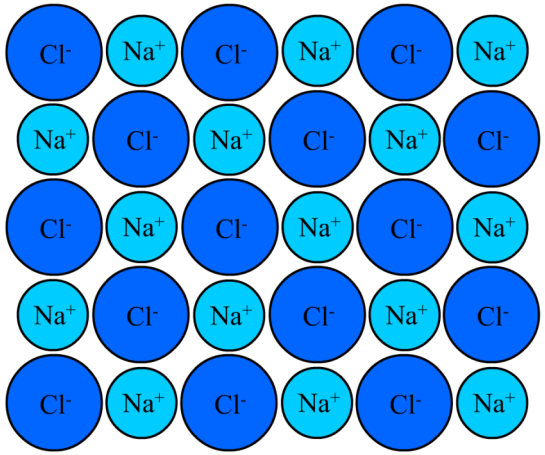
HfNCl



- ionic crystal:

NaCl





Na: "small" ionization energy

Cl: "large" electron affinity

$Na^+ \xrightarrow{electron} Cl^-$

gain of attractive Coulomb energy

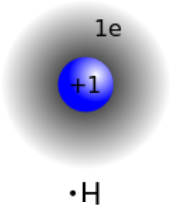
(Madelung energy)

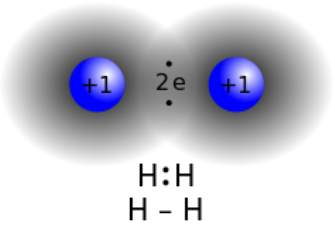
cohesive forces

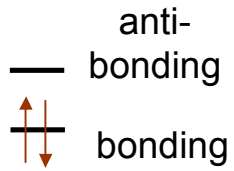
- covalent bonds:

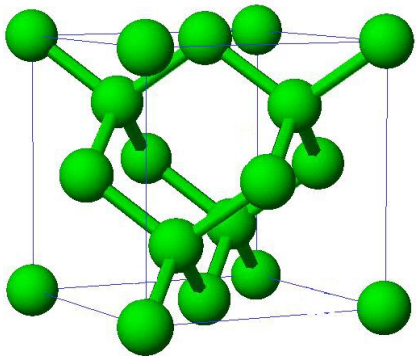
open-shell atoms

shared electrons









diamonds

completely filled
molecular orbitals

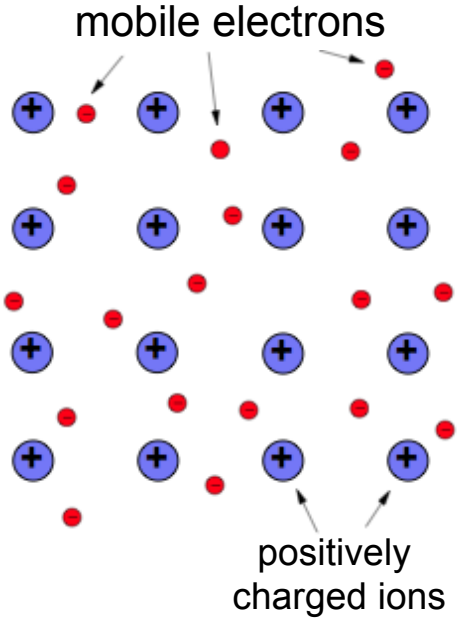
localized electrons
insulator

- metallic cohesion:

Pauli exclusion principle
of electrons

reduces Coulomb repulsion,
but increases kinetic energy

short-range repulsion
long-range attraction



good account for
alkali metals
Li, Na, K, …