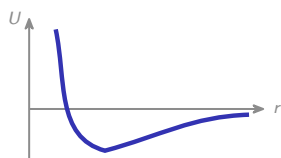


Compound Structure and Properties

AP Chemistry ■ Unit 2

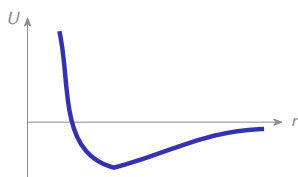
AP Chemistry



Compound Structure and Properties

What we will cover

- 1 Types of chemical bonds
- 2 Bond energy and length
- 3 Ionic solids
- 4 Metals and alloys
- 5 Lewis diagrams and resonance
- 6 VSEPR and hybridization



1

Bond types

Types of chemical bonds

A **chemical bond** 化学键 forms by what atoms do with valence electrons:

- **ionic** 离子键 – metal **transfers** to nonmetal
- **covalent** 共价键 – two nonmetals **share**
- **metallic** 金属键 – a shared electron sea



Network solids bond in giant lattices

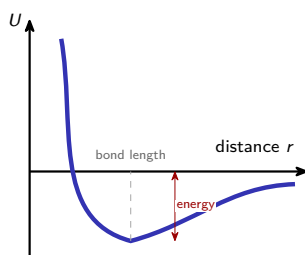
2 Bond energy

Bond energy and length

As two atoms approach, potential energy dips to a well:

- **bond length** 键长 – the distance at the minimum
- **bond energy** 键能 – the depth of the well

Higher **bond order** 键级 (single → double → triple) ⇒ **shorter and stronger**.



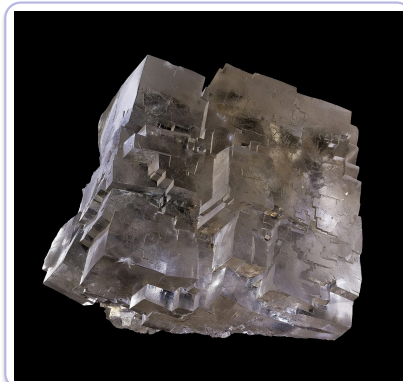
3 Ionic solids

Ionic solids

Ions pack into a repeating **crystal lattice** 晶格, glued by **Coulombic attraction** 库仑吸引.

- higher charges + smaller ions $\Rightarrow$ bigger **lattice energy** 晶格能
- high melting points; **brittle** 脆性 (a shifted layer repels)

MgO ($2+/2-$) melts far hotter than NaCl ($1+/1-$).



Ionic solids form ordered lattices

4 Metals

Metals and alloys

The **sea of electrons** 电子海: fixed + ions in a sea of **delocalized electrons** 离域电子.

This explains:

- **conductivity** (electrons drift)
- **malleability** 延展性 (layers slide)
- **luster** 光泽 (electrons reflect light)

Alloys 合金: substitutional (brass) or interstitial (steel) – both harder.



Metals share a sea of delocalised electrons

5 Lewis

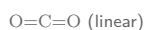
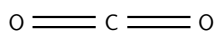
Lewis diagrams and resonance

A **Lewis diagram** 路易斯结构式 shows shared **bonds** 共价键 (lines) and **lone pairs** 孤对电子, aiming for an **octet** 八隅规则.

Formal charge picks the best

$$FC = V - (\text{lone}) - (\text{bonds})$$

Resonance 共振: when several equal structures exist, the real bonds are an **average** (delocalized).



6

VSEPR

Compound Structure and Properties

↳ VSEPR

VSEPR and hybridization

VSEPR 价层电子对互斥理论: electron domains push as far apart as possible.

- 2 domains – sp – linear
- 3 – sp^2 – trigonal planar
- 4 – sp^3 – tetrahedral

Lone pairs bend the shape; geometry decides **polarity** 分子极性.



linear



trigonal



tetrahedral

7

Recap

Unit 2 – key takeaways

1 Bond types

Δ EN sets ionic / polar / nonpolar covalent

2 Bond well

depth = energy, minimum = length; order shortens it

3 Structures

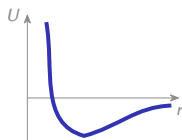
ionic lattice; metals a sea of delocalized electrons

4 Shape

VSEPR: 2/3/4 domains $\rightarrow$ linear/trigonal/tetrahedral

Check yourself

- 1** A large electronegativity difference gives which bond type?
- 2** Going single $\rightarrow$ double $\rightarrow$ triple, how does bond length change?
- 3** Why do metals conduct electricity?
- 4** A central atom with 4 electron domains has what shape?



Answers 1. ionic 2. it shortens 3. delocalized electrons drift 4. tetrahedral