General Chemistry

Chemical Bonding II

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Chapter Description

- <u>Expected Outcome:</u>
- At the end of the lecture, the students should be able to understand and solve the problems regarding on Overlap and Hybridization, Intermolecular Forces, Metallic Bond

- <u>Reference:</u>
  - Chemistry for matriculation semester 1, Tan Yin Toon, Sheila Shamuganathan. Companion website.

Contents

- Overlap and Hybridization
- Intermolecular Forces
- Metallic Bond

VALENCE BOND THEORY

A covalent bond is formed by pairing of two electrons with opposing spins in the region of overlap of atomic orbitals between two atoms.

This overlap region has a high electron charge density.

Two type of bonds: Sigma (σ) bond and pi (π) bond

FORMATION OF SIGMA BOND

Has highest electron density along the bond axis

Allow free rotation

All single bonds are σ bond

FORMATION OF PI BOND

Resulting from side–to–side overlap. Occurs in molecules with multiple bonds

Has two regions of electron density one above and one below the σ–bond axis

One π bond hold two electrons that move through both regions of the bond.

π bond restricts rotation

HYBRIDISATION

Mixing of two or more orbitals in an atom to form a new set of hybrid orbitals

The spatial orientation of the new orbitals is cause more stable bonds and are consistent with the observed molecular shape

STEPS IN DETERMINING THE HYBRID ORBITALS

Determine hybrid orbitals

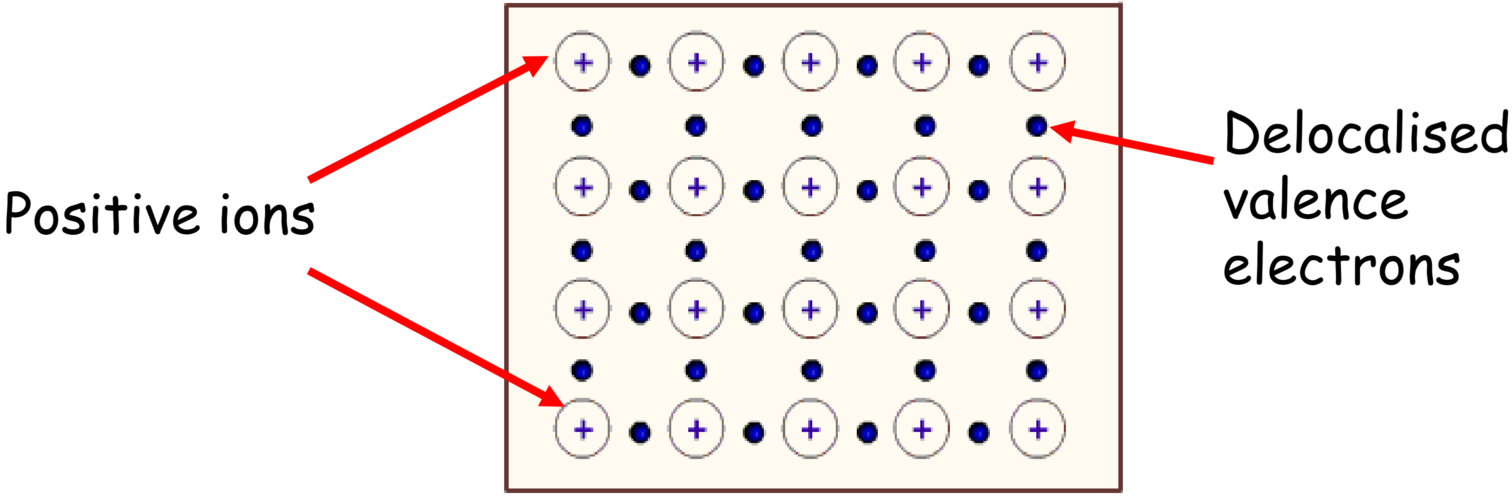
1. Draw the most plausible Lewis structure
2. Predict molecular geometry shape using VSEPR
3. Deduce the hybridisation of central atoms
4. Draw the orbital diagram for the central and terminal atoms and explain
5. Draw the overlapping orbital

FORMATION OF METALLIC BOND

Electrostatic force between the positively charged metallic ions and the ‘sea’ of electrons.

FORMATION OF METALLIC BOND

The electron sea model



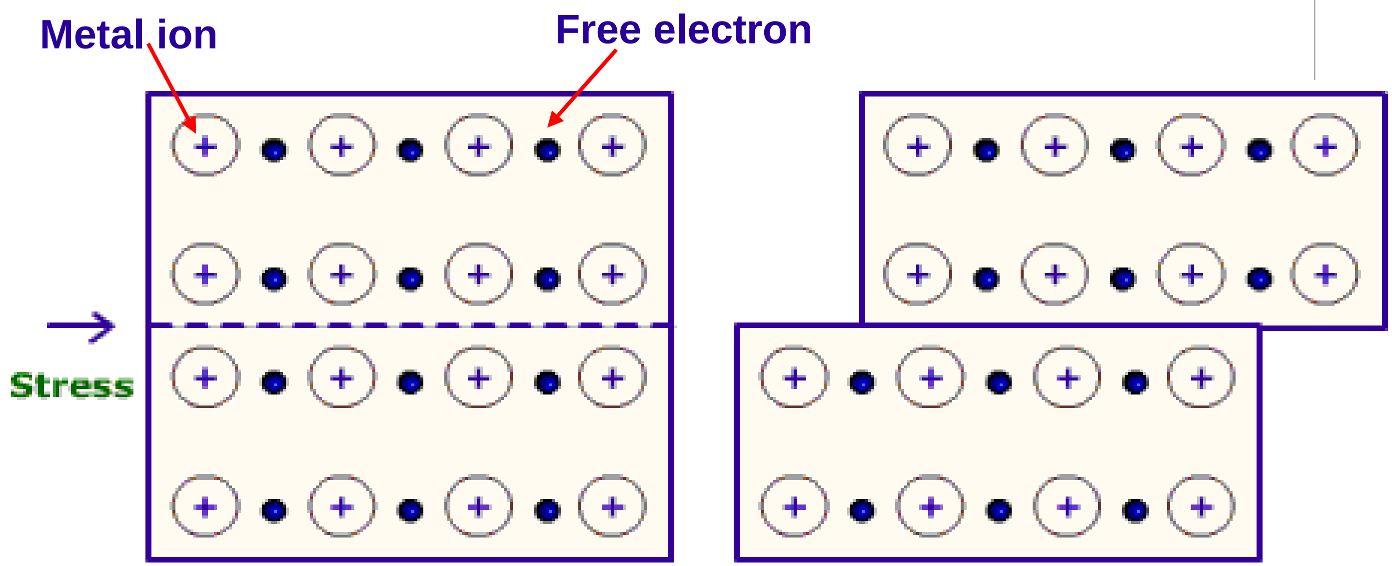
FORMATION OF METALLIC BOND

In a metallic bond, metal atoms can be imagined as an array of positive ions immersed in a sea of delocalized valence electrons.

These delocalized electrons are not bound to individual atoms and they can therefore serve to bind large numbers of metal atoms together.

PROPERTIES OF METAL

Malleability	Is the ability of a metal to be hammered into
Ductility	Is the ability of a metal to be drawn into wire. Whenever any stress is applied to the metals, one layer of atoms can slide over another without disrupting the metallic bonding.



PROPERTIES OF METAL

Electrical conductivity	Good conductors of electricity
	When an electrical potential is applied to the metal, the mobile electrons will move towards the positive terminal and thus conducts electricity.
Thermal conductivity	Good conductors of heat
	When one end of the metal is heated, the kinetic energy of the electrons increases. This is then transmitted to the other end by the system of delocalized mobile electrons.

FACTORS AFFECTING THE STRENGTH OF METALLIC BOND

Based on the number of valence electron.

The strength of metallic bonding	α	$\dfrac{\textbf{no. of valence e per atom}}{\textbf{radius of the atom}}$

FACTORS AFFECTING THE STRENGTH OF METALLIC BOND

So, the bonding will be lower in sodium (1 valence e) compared to magnesium (2 valence e) and aluminium (3 valence e).

Therefore the melting and boiling point of Na < Mg < Al.

EFFECT THE STRENGTH OF METALLIC BOND ON BOILING POINT

The stronger the metallic bond, the higher the melting point and boiling point.

The melting points and the boiling points for elements in group 1,2,13 and the block.

Element	Na	Mg	Al	Li	Be	B
Melting point (°C)	98	650	660	180	1280	2300
Boiling point (°C)	892	1107	2450	1330	2480	3930
No. of valence electron	1	2	3	1	2	3

Author Information

Aini Hidayah Mohamed is a lecturer from Faculty of Industrial Sciences & Technology Industry, Universiti Malaysia Pahang, Malaysia. She is also a chemist who is expert in general chemistry, industrial chemistry and natural product.