Edgenuity

Warm-Up | Metallic Bonding

Metals

Metals

- Located mainly in [s], *d*, and *f* blocks of the periodic table
- Common properties:
  - [Malleable]
  - Ductile
  - High [conductivity] (heat and electricity)
  - Shiny
  - Most are silver in color

Lesson Objectives

By the end of this lesson, you should be able to:

- Describe how metallic [bonds] form.
- Describe the properties of metals, including [thermal] conductivity, electrical conductivity, malleability, and ductility.

Science Practice: Apply the theory of metallic bonding to explain metallic properties.

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Words to Know

Write the letter of the definition next to the matching word as you work through the lesson. You may use the glossary to help you.

D delocalized electrons

C alloy

B molecular orbitals

A electron sea model

A. the most commonly used model for bonding in metals, which assumes that electrons flow easily between metal nuclei

B. the atomic orbitals that combine to form shared orbitals

C. a homogeneous mixture of two or more metals

D. mobile electrons that are not associated with specific atoms in metal crystals

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Lesson Question

What are the properties of metals? How do metals form bonds with each other?

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Delocalized Electrons

Some properties of metals:

- Large [atoms]
- Relatively [low] electronegativities
- Low ionization energies

These properties allow:

- electrons of [metals] to roam.
- electrons to be shared among all metal nuclei.
- **Delocalized electrons**: are [mobile] electrons that are not associated with specific atoms in metal crystals

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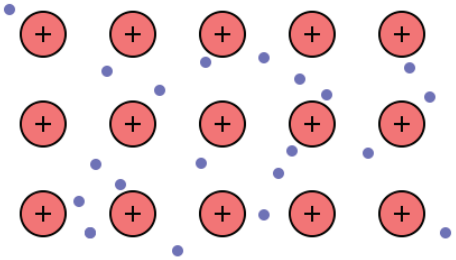
The Electron Sea Model

Metallic bonding results from the sharing of valence electrons.



- Delocalized electrons: act like glue.
- **Electron sea model**: Most commonly used model for bonding in metals; electrons are assumed to flow easily between metal nuclei
- Simplest metal-bonding model

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From Bonds to Bands

Molecular **orbitals**: atomic orbitals that combine to form shared orbitals

- Many atoms = many molecular orbitals
- Metal molecular orbitals combine to form bands
  - Electrons can move between bands.

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Conductivity

Metals conduct heat and electricity well.

- Delocalized electrons = easy electron movement
  - Moving electrons carry current, thermal energy
- More valence electrons, larger atomic radius = higher conductivity

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Malleability, Ductility, and Luster

Metals are malleable, ductile, and exhibit luster.

- Delocalized electrons = easy to deform metal
- Easy electron [movement] = "flexible" bonds
  - Metals = malleable and ductile instead of brittle
- Movement of electrons between bands = shiny, metallic [luster]
  - Oscillation of electrons between [bands] emits light

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Alloys

Alloy: homogeneous mixture of two or more metals

- Properties of alloy = different from properties of [pure] metals
- Composition can vary from sample to sample

Alloy	Component Metals
Bronze	Copper and tin or aluminum
Brass	Copper and zinc
Rose gold	Gold and copper
Steel	Iron, chromium, and nickel

Summary | Metallic Bonding

Lesson Question

What are the properties of metals? How do metals form bonds with each other?

Answer

(Sample answer) Metals are malleable, ductile, good conductors of heat and electricity, shiny, and mostly silver in color. Metallic bonding is caused due to the flow of electrons between metal nuclei.

Slide 2

Metallic Bonding

- The electron sea model is the [simplest] model of metallic bonding.
- In the electron sea model, atomic nuclei are arranged in a regular pattern and electrons move easily among them.
- The electron sea model can explain some, but not all, properties of metals.
- The band theory states that [molecular] orbitals in metals overlap to produce bands. Electrons can move among the bands.
- [Band] theory explains more of the properties of metals than the electron sea model.

Summary | Metallic Bonding

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Metal Properties

- The movement of electrons between bands explains the conductivity of metals.
- Easy electron movement also explains malleability, ductility, and the shininess of metals.
- In general, the more valence electrons an atom has and the larger its atomic radius, the more conductive and malleable it is.

Use this space to write any questions or thoughts about this lesson.