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Warm-Up | Metallic Bonding

Metals

Metals

- Located mainly in [ ], *d*, and *f* blocks of the periodic table
- Common properties:
  - [ ]
  - Ductile
  - High [ ] (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 [ ] form.
- Describe the properties of metals, including [ ] 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.

_____ delocalized electrons

_____ alloy

_____ molecular orbitals

_____ 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

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Delocalized Electrons

Some properties of metals:

- Large _____
- Relatively _____ electronegativities
- Low ionization energies

These properties allow:

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

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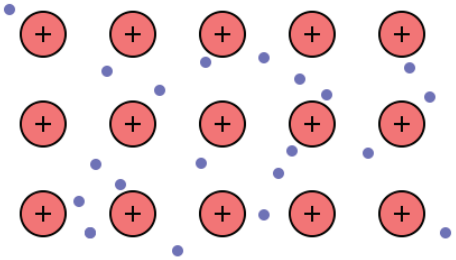
The Electron Sea Model

Metallic bonding results from the sharing of valence electrons.



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

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From Bonds to Bands

[ ] **orbitals**: atomic orbitals that combine to form [ ] orbitals

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

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Conductivity

Metals [ ] heat and electricity well.

- Delocalized electrons = easy electron movement
  - Moving electrons carry current, thermal energy
- More valence electrons, larger [ ] 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 _____ = "flexible" bonds
  - Metals = malleable and ductile instead of brittle
- Movement of electrons between bands = shiny, metallic _____
  - Oscillation of electrons between _____ emits light

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Alloys

Alloy: homogeneous mixture of two or more metals

- Properties of alloy = different from properties of _____ metals
- Composition can vary from sample to sample

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

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Summary | Metallic Bonding

Lesson Question

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

Answer

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Metallic Bonding

- The electron sea model is the _____ 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 _____ orbitals in metals overlap to produce bands. Electrons can move among the bands.
- _____ theory explains more of the properties of metals than the electron sea model.

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Summary | Metallic Bonding

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Metal Properties

- The movement of electrons between bands explains the _____ of metals.
- Easy electron movement also explains malleability, ductility, and the shininess of metals.
- In general, the more _____ 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.

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