Metalloids

Jean Brainard, Ph.D.
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What is this intricate orb? It is the greatly magnified skeleton of single-celled ocean organisms call radiolarian. The skeleton is made of an element that is extremely common on Earth. In fact, it is the second most abundant element in Earth’s crust. It is also one of the most common elements in the entire universe. What is this important element? Its name is silicon, and it belongs to a class of elements called metalloids.

**What Are Metalloids**

**Metalloids** are the smallest class of elements. (The other two classes of elements are metals and nonmetals). There are just six metalloids. In addition to silicon, they include boron, germanium, arsenic, antimony, and tellurium. Metalloids fall between metals and nonmetals in the periodic table. They also fall between metals and nonmetals in terms of their properties.

**Q:** How does the position of an element in the periodic table influence its properties?
Elements are arranged in the periodic table by their atomic number, which is the number of protons in their atoms. Atoms are neutral in electric charge, so they always have the same number of electrons as protons. It is the number of electrons in the outer energy level of atoms that determines most of the properties of elements.

**Chemical Properties of Metalloids**

How metalloids behave in chemical interactions with other elements depends mainly on the number of electrons in the outer energy level of their atoms. Metalloids have from three to six electrons in their outer energy level. Boron, pictured in the Figure 1.1, is the only metalloid with just three electrons in its outer energy level. It tends to act like metals by giving up its electrons in chemical reactions. Metalloids with more than four electrons in their outer energy level (arsenic, antimony, and tellurium) tend to act like nonmetals by gaining electrons in chemical reactions. Those with exactly four electrons in their outer energy level (silicon and germanium) may act like either metals or nonmetals, depending on the other elements in the reaction.

**Physical Properties of Metalloids**

Most metalloids have some physical properties of metals and some physical properties of nonmetals. For example, metals are good conductors of both heat and electricity, whereas nonmetals generally cannot conduct heat or electricity. And metalloids? They fall between metals and nonmetals in their ability to conduct heat, and if they can conduct electricity, they usually can do so only at higher temperatures. Metalloids that can conduct electricity at higher temperatures are called semiconductors. Silicon is an example of a semiconductor. It is used to make the tiny electric circuits in computer chips. You can see a sample of silicon and a silicon chip in the Figure 1.2.

Metalloids tend to be shiny like metals but brittle like nonmetals. Because they are brittle, they may chip like glass or crumble to a powder if struck. Other physical properties of metalloids are more variable, including their boiling
and melting points, although all metalloids exist as solids at room temperature. You can learn about the properties of specific metalloids by watching the video at this URL:

http://www.youtube.com/watch?v=NO36yksPOBM (6:50)

**Summary**

- Metalloids are the smallest class of elements, containing just six elements. They fall between metals and nonmetals in the periodic table.
- How metalloids behave in chemical interactions with other elements depends mainly on the number of electrons in the outer energy level of their atoms. Metalloids may act either like metals or nonmetals in chemical reactions.
- Most metalloids have some physical properties of metals and some physical properties of nonmetals. They fall between metals and nonmetals in their ability to conduct heat and electricity. They are shiny like metals but brittle like nonmetals. All exist as solids at room temperature.
Vocabulary

- **metalloid**: Class of elements that have some properties of metals and some properties of nonmetals.

Practice

Because metalloids are similar in some ways to metals and in other ways to nonmetals, to understand metalloids you need to know about these other two classes of elements. Watch the following video on classes of elements. Then, using information from the video, make a table comparing and contrasting metals, nonmetals, and metalloids.

[Video Link]

http://www.youtube.com/watch?v=q7wy8ycpE48 (5:41)

Review

1. What are metalloids? Which elements are placed in this class of elements?
2. Identify physical properties of metalloids that resemble those of metals.
3. Which physical property of metalloids is like that of nonmetals?
4. Explain the variation in how metalloids react with other elements.
5. Do a Web quest to learn more about semiconductors and why they are used in computer chips. Summarize what you learn in a written report or poster.

References

1. Jurii. . CC-BY 3.0