Mentioned in the Hebrew scriptures, tin is of ancient origins. Tin is an element in Group 14 (the carbon family) and has mainly metallic properties. Tin has atomic number 50 and an atomic mass of 118.710 atomic mass units.

**Introduction**

Mentioned in the Hebrew scriptures, tin is of ancient origins. Early metal smiths were quick to learn that mixing copper with tin created a more durable metal (bronze) and it is principally for its alloys that tin is valued today. Named after the Etruscan god Tinia, the chemical symbol for tin is taken from the Latin *stannum*. The metal is silvery white and very soft when pure. It has the look of freshly cut aluminum, but the feel of lead.

Polished tin is slightly bluish. It has been used for many years in the coating of steel cans for food because it is more resistant to corrosion than iron. It forms a number of useful low-melting alloys (solders) which are used to connect electrical circuits. Bending a bar of tin produces a characteristic squealing sound called "tin cry". Tin shares chemical similarities with germanium and lead. Tin mining began in Australia in 1872 and today Tin is used extensively in industry and commerce.

<table>
<thead>
<tr>
<th>Table 1: Basic Properties of tin</th>
</tr>
</thead>
<tbody>
<tr>
<td>color</td>
</tr>
<tr>
<td>hardness</td>
</tr>
<tr>
<td>atomic radius</td>
</tr>
<tr>
<td>density</td>
</tr>
<tr>
<td>melting point</td>
</tr>
<tr>
<td>boiling point</td>
</tr>
<tr>
<td>electrical conductivity</td>
</tr>
<tr>
<td>electrode potential</td>
</tr>
<tr>
<td>first ionization energy</td>
</tr>
<tr>
<td>Ionic Radius</td>
</tr>
</tbody>
</table>

**Reactions of Tin**

| Hydrogen | Tin not affected |
Nitrogen

Tin absorbs it instead of hydrogen in electric discharge

Argon

No sign of a combination of Tin with Argon

Fluorine

Does not react with Tin at low temperatures, but at 100 degrees Celsius they form stannic fluoride. Perhaps one of the most familiar of tin compounds, \(\text{SnF}_2\), tin(II) fluoride, goes by the trade name of fluoristan and is found in some fluoride toothpastes.

Chlorine

Acts on Tin at room temperature

Bromine

Acts on tin at room temperature

Sulfur

Unites directly with Tin when heated

Selenium

Reacts vigorously with Tin

Tellurium

Reacts vigorously with Tin

Nitrogen

Forms on compound by direct union with Tin

Arsenic

Reacts with tin under heat and light

Antimony

Is dissolved by molten Tin

---

### Reaction of tin with oxygen

When heated in it, tin produces stannic oxide

\[
\text{Sn}_\text{(s)} + \text{O}_\text{(g)} \rightarrow \text{SnO}_\text{2(s)}
\]

---

### Reaction of tin with water (steam)

\[
\text{Sn}_\text{(s)} + 2\text{H}_2\text{O}_\text{(g)} \rightarrow \text{SnO}_\text{2(s)} + 2\text{H}_\text{(2(g))}
\]

---

### Isotopes

There are 10 known stable isotopes of Tin, the most of any elements on the periodic table. This high number of stable isotopes could be attributed to the fact that the atomic number of \(\text{\text{^{50}Sn}}\) is a 'magic number' in nuclear physics.

<table>
<thead>
<tr>
<th>Isotope</th>
<th>% Natural Abundance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Allotropes of Tin

Tin has 3 allotropes: alpha, beta and gamma tin. Alpha tin is the most unstable form of tin. Beta tin is the most commonly found allotrope of tin and gamma tin only exists at very high temperatures.

Oxidation States of Tin

Tin, although it is found in Group 14 of the periodic table, is consistent with the trend found in Group 13 where the lower oxidation state is favored farther down a group. Tin can exist in two oxidation states, +2 and +4, but Tin displays a tendency to exist in the +4 oxidation state.

Common Compounds of Tin

Tin forms two main oxides, SnO and SnO₂ (amphoteric).

Electron Configuration of Tin

Tin has a ground state electron configuration of $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^2$ and can form covalent tin (II) compounds with its two unpaired p-electrons. In the three dimensional figure below, the first and most inner electron shell is represented by blue electrons, the second electron shell made up of eight electrons is represented by red electrons, the third shell containing eighteen electrons is represented with green electrons, and the next outer electron again contains eighteen electrons and represented in purple.
Uses of Tin

Early metal smiths were quick to learn that mixing copper with tin created a more durable metal (bronze) and it is principally for its alloys that tin is valued today. Nearly half of the tin metal produced is used in solders, which are low melting point alloys used to join wires. Solders are important in electrician work and plumbing. Tin is also used as a coating for lead, zinc, and steel to prevent corrosion. Tin cans are widely used for storing foods; the first tin can was used in London in 1812.

Questions

Find the oxidation state of tin in the following compounds:

a. SnCl^2 answer:2
b. SnO^2 answer:4

Write an equation for the reaction of tin with water. Under what conditions does this reaction take place?

answer: Sn(s) + 2H_2O(g) → SnO_2(s) + 2H_2(g) Reaction takes place if water is heated to a high temperature to form steam.

Which of these reactions take place.

a. tin with oxygen ANSWER: YES
b. tin with hydrogen ANSWER: NO
c. tin with argon ANSWER: NO
d. tin with chlorine ANSWER: YES

Arrange the following in order of increasing atomic radius: Sn, K, Ag, C, Pb

ANSWER: C<Sn<Pb<Ag<K

Arrange the following in order of decreasing ionization energy: Sn, Si, Pb, I, In.

ANSWER: Si> I > Sn > In > Pb

References


---

**Contributors**

- Taylor Hughes, (UCSB)