The noble gases (Group 18) are located in the far right of the periodic table and were previously referred to as the "inert gases" due to the fact that their filled valence shells (octets) make them extremely nonreactive.

The Chemical Properties

Noble gases are odorless, colorless, nonflammable, and monotonic gases that have low chemical reactivity.

<table>
<thead>
<tr>
<th>Atomic Number</th>
<th>Element</th>
<th>Number of Electrons/Shell</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Helium</td>
<td>2</td>
</tr>
<tr>
<td>10</td>
<td>Neon</td>
<td>2,8</td>
</tr>
<tr>
<td>18</td>
<td>Argon</td>
<td>2,8,8</td>
</tr>
<tr>
<td>36</td>
<td>Krypton</td>
<td>2,8,18,8</td>
</tr>
<tr>
<td>54</td>
<td>Xenon</td>
<td>2,8,18,18,8</td>
</tr>
<tr>
<td>86</td>
<td>Radon</td>
<td>2,8,18,32,18,8</td>
</tr>
</tbody>
</table>

The full valence electron shells of these atoms make noble gases extremely stable and unlikely to form chemical bonds because they have little tendency to gain or lose electrons. Although noble gases do not normally react with other elements to form compounds, there are some exceptions. Xe may form compounds with fluoride and oxide.

Example 1: Xenon Fluorides

**Xenon Difluoride** \((\text{XeF}_2)\)

- Dense white crystallized solid
- Powerful fluorinating agent
- Covalent inorganic fluorides
- Stable xenon compound
- Decomposes on contact with light or water vapor
- Linear geometry
- Moisture sensitive
- Low vapor pressure
Xenon Tetrafluoride ($\text{XeF}_4$)

**Figure:** On Oct. 2, 1963, Argonne announced the creation of xenon tetrafluoride, the first simple compound of xenon, a noble gas widely thought to be chemically inert.

- Colorless Crystals
- Square planar geometry
- Discovered in 1963

Xenon Hexafluoride ($\text{XeF}_6$)

**Figure:** \(\text{XeF}_6\) geometric structure with center Xe atom flanked by six F atoms. Figure used with permission from Wikipedia.

- Strongest fluorinating agent
• Colorless solid
• Highest coordination of the three binary fluorides of xenon (XeF₂ and XeF₄)
• Formation is exergonic, and the compound is stable at normal temperatures
• Readily sublimes into intense yellow vapors
• Structure lacks perfect octahedral symmetry

Example 2: Xenon Oxide

**Xenon Tetroxide (XeO₄)**

![Xenon Tetroxide Diagram]

• Yellow crystalline solid
• Relatively stable
• Oxygen is the only element that can bring xenon up to its highest oxidation state of +8

Two other short-lived xenon compounds with an oxidation state of +8, XeO₃F₂ and XeO₂F₄, are produced in the reaction of xenon tetroxide with xenon hexafluoride.

Example 3: Radon Compounds

Radon difluoride (RnF₂) is one of the few reported compounds of radon. Radon reacts readily with fluorine to form a solid compound, but this decomposes on attempted vaporization and its exact composition is uncertain. The usefulness of radon compounds is limited because of the noble gas's radioactivity. The longest-lived isotope, ²²²Ra, has a half-life of only 3.82 days.