Periodic acid is the highest oxoacid of iodine, in which the iodine exists in oxidation state VII. Like all periodates it can exist in two forms: orthoperiodic acid, with the chemical formula $H_5IO_6$ and metaperiodic acid, which has the formula $HIO_4$. Periodic acid was discovered by Heinrich Gustav Magnus and C. F. Ammermüller in 1833.

**Orthoperiodic Acid Metaperiodic Acid**

![Orthoperiodic Acid](https://via.placeholder.com/150)

By NEUROtiker (Own work) [Public domain], via Wikimedia Commons

![Metaperiodic Acid](https://via.placeholder.com/150)

By Benjah-bmm27 (Own work) [Public domain], via Wikimedia Commons

**Synthesis**

Modern industrial scale production involves the electrochemical oxidation of iodic acid, on a PbO$_2$ anode, with the following standard electrode potential:

$$H_5IO_6 + H^+ + 2 e^- \rightarrow IO^{-3} + 3 H_2O \ E^° = 1.6 \ V$$
Orthoperiodic acid can be dehydrated to give metaperiodic acid by heating to 100 °C

\[ \text{HIO}_4 + 2 \text{H}_2\text{O} \rightleftharpoons \text{H}_5\text{IO}_6 \]

Further heating to around 150 °C gives iodine pentoxide (I\(_2\)O\(_5\)) rather than the expected anhydride diiodine heptoxide (I\(_2\)O\(_7\)). Metaperiodic acid can also be prepared by from various orthoperiodates by treatment with dilute nitric acid.

\[ \text{H}_5\text{IO}_6 \rightarrow \text{HIO}_4 + 2 \text{H}_2\text{O} \]

**Properties**

Orthoperiodic acid has a number of acid dissociation constants. The pKa of metaperiodic acid has not been determined.

\[ \text{H}_5\text{IO}_6 \rightarrow \text{H}_4\text{IO}^- + \text{H}_3\text{O}^+ \text{, pKa = 3.29} \]

\[ \text{H}_4\text{IO}^- \rightarrow \text{H}_3\text{IO}^{2-} + \text{H}_2\text{O} \text{, pKa = 8.31} \]

\[ \text{H}_3\text{IO}^{2-} \rightarrow \text{H}_2\text{IO}^{3-} + \text{H}_2\text{O} \text{, pKa = 11.60} \]

There being two forms of periodic acid, it follows that two types of periodate salts are formed. For example, sodium metaperiodate, NaIO\(_4\), can be synthesised from HIO\(_4\) while sodium orthoperiodate, Na\(_5\)IO\(_6\) can be synthesised from H\(_5\)IO\(_6\).

**Structure**

Orthoperiodic acid forms monoclinic crystals (space group P\(_{21}/n\)) consisting of slightly deformed IO\(_6\) octahedron interlinked via bridging hydrogens. The crystal structure of metaperiodic acid also includes IO\(_6\) octahedron, however these are connected via cis-edge-sharing with bridging oxygens to form one-dimensional infinite chains.

**Reactions**

Like all periodates, periodic acid can be used to cleave various 1,2-difunctional compounds. Most notably, periodic acid will cleave vicinal diols into two aldehyde or ketone fragments.

By Project Osprey (Own work) [CC BY-SA 3.0 (http://creativecommons.org/licenses/by-sa/3.0)], via Wikimedia Commons

This can be useful in determining the structure of carbohydrates as periodic acid can be used to open saccharide rings. This process is often used in labeling saccharides with fluorescent molecules or other tags such as biotin. Because the
process requires vicinal diols, periodate oxidation is often used to selectively label the 3′-termini of RNA (ribose has vicinal diols) instead of DNA as deoxyribose does not have vicinal diols.

Periodic acid is also used in as an oxidising agent of moderate strength.

Other oxyacids

Periodate is part of a series of oxyacids in which iodine can assume oxidation states of −1, +1, +3, +5, or +7. A number of neutral iodine oxides are also known.

<table>
<thead>
<tr>
<th>Iodine Oxidation State</th>
<th>-1</th>
<th>+1</th>
<th>+3</th>
<th>+5</th>
<th>+7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Hydrogen iodide</td>
<td>Hypoiodous acid</td>
<td>Iodous acid</td>
<td>Iodic acid</td>
<td>Periodic acid</td>
</tr>
<tr>
<td>Formula</td>
<td>HI</td>
<td>HIO</td>
<td>HIO2</td>
<td>HIO3</td>
<td>HIO4 or H5IO5</td>
</tr>
</tbody>
</table>

References


Contributors

- Wikipedia (CC-BY-SA-3.0)