

Thallium

TI

General Information

Discovery

Thallium was discovered spectroscopically by W. Crookes in 1861 in London. It was isolated in 1862 by C.-A. Lamy in Paris.

Appearance

Thallium is a soft, silvery metal, but it soon develops a bluish-grey tinge as the oxide forms if it is exposed to the air.

Source

Thallium is found in several ores, one of which is pyrites, used in the production of sulphuric acid. The commercial source of thallium is as a by-product of pyrites roasting in sulphuric acid production. It can also be obtained from the smelting of lead and zinc ores. Thallium is also present in manganese nodules found on the ocean floor.

Uses

The use of thallium is limited as it is a toxic element. Thallium sulfate was employed as a rodent killer - it is odourless and tasteless - but household use of this poison has been prohibited in most western countries. Thallium oxide is used to produce glasses with a high index of refraction, and also low melting glasses which become fluid at about 125K.

Biological Role

Thallium has no known biological role. It is very toxic and teratogenic. Contact of the metal with the skin is dangerous, and there is evidence that the vapour is both teratogenic and carcinogenic.

General Information

Thallium is soft, malleable and can be cut with a knife. It tarnishes readily in moist air and reacts with steam to form the hydroxide. It is attacked by all acids, most rapidly nitric acid.

Physical Information

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|--|---|
| Atomic Number | 81 |
| Relative Atomic Mass ($^{12}\text{C}=12.000$) | 204.38 |
| Melting Point/K | 576.7 |
| Boiling Point/K | 1730 |
| Density/kg m ⁻³ | 11850 (293K) |
| Ground State Electron Configuration | [Xe]4f ¹⁴ 5d ¹⁰ 6s ² 6p ¹ |
| Electron Affinity (M-M ⁻)/kJ mol ⁻¹ | -30 |

Key Isotopes

| Nuclide | ²⁰³ Tl | ²⁰⁴ Tl | ²⁰⁵ Tl | ²⁰⁸ Tl |
|-------------------|-------------------|-------------------|-------------------|-------------------|
| Atomic mass | 202.97 | | 204.97 | |
| Natural abundance | 29.52% | 0% | 70.48% | trace |
| Half-life | stable | 3.81 yrs | stable | 3.1 mins |

Ionisation Energies/kJ mol⁻¹

| | |
|------------------------------------|-------|
| M - M ⁺ | 589.3 |
| M ⁺ - M ²⁺ | 1971 |
| M ²⁺ - M ³⁺ | 2878 |
| M ³⁺ - M ⁴⁺ | 4900 |
| M ⁴⁺ - M ⁵⁺ | 6100 |
| M ⁵⁺ - M ⁶⁺ | 8300 |
| M ⁶⁺ - M ⁷⁺ | 9500 |
| M ⁷⁺ - M ⁸⁺ | 11300 |
| M ⁸⁺ - M ⁹⁺ | 14000 |
| M ⁹⁺ - M ¹⁰⁺ | 16000 |

Other Information

| | |
|---|------------------|
| Enthalpy of Fusion/kJ mol ⁻¹ | 4.31 |
| Enthalpy of Vaporisation/kJ mol ⁻¹ | 166.1 |
| Oxidation States | |
| Main | Tl ⁺¹ |
| Others | Tl ⁺³ |
| Covalent Bonds/kJ mol⁻¹ | |
| Tl ⁺¹ - H | 185 |
| Tl ⁺³ - C | 125 |
| Tl ⁺³ - O | 375 |
| Tl ⁺³ - F | 460 |
| Tl ⁺³ - Cl | 368 |
| Tl - Tl | 63 |