

Molybdenum

Mo

General Information

Discovery

Molybdenum was discovered by P.J. Hjelm in 1781 in Uppsala, Sweden.

Appearance

The metal is silver-white and fairly soft when pure. It is usually obtained as a grey powder.

Source

The main source of this element is the ore molybdenite. Molybdenum can be obtained from this ore, but most commercial production is as a by-product of copper production.

Uses

Molybdenum is a valuable alloying agent, as it contributes to the hardness and toughness of quenched and tempered steels. It is also used in certain nickel-based alloys which are heat-resistant and corrosion-resistant to chemical solutions. It has found use in electrical and nuclear applications, and as a catalyst in the refining of petroleum.

Biological Role

Molybdenum is an essential element for animals and plants. If soil lacks this element the land is barren.

Physical Information

| | |
|--|-------------------------------------|
| Atomic Number | 42 |
| Relative Atomic Mass ($^{12}\text{C}=12.000$) | 95.94 |
| Melting Point/K | 2890 |
| Boiling Point/K | 4885 |
| Density/kg m ⁻³ | 10220 (293K) |
| Ground State Electron Configuration | [Kr]4d ⁵ 5s ¹ |
| Electron Affinity (M-M ⁻)/kJ mol ⁻¹ | 114 |

Key Isotopes

| Nuclide | ⁹² Mo | ⁹⁴ Mo | ⁹⁵ Mo | ⁹⁶ Mo | ⁹⁷ Mo | ⁹⁸ Mo |
|-------------------|------------------|-------------------|------------------|------------------|------------------|------------------|
| Atomic mass | 91.91 | 93.90 | 94.91 | 95.90 | 96.91 | 97.91 |
| Natural abundance | 14.84% | 9.25% | 15.92% | 16.68% | 9.55% | 24.13% |
| Half-life | stable | stable | stable | stable | stable | stable |
| Nuclide | ⁹⁹ Mo | ¹⁰⁰ Mo | | | | |
| Atomic mass | | 99.91 | | | | |
| Natural abundance | 0% | 9.63% | | | | |
| Half-life | 66.69 h | stable | | | | |

Ionisation Energies/kJ mol⁻¹

| | |
|------------------------------------|-------|
| M - M ⁺ | 685 |
| M ⁺ - M ²⁺ | 1558 |
| M ²⁺ - M ³⁺ | 2621 |
| M ³⁺ - M ⁴⁺ | 4480 |
| M ⁴⁺ - M ⁵⁺ | 5900 |
| M ⁵⁺ - M ⁶⁺ | 6560 |
| M ⁶⁺ - M ⁷⁺ | 12230 |
| M ⁷⁺ - M ⁸⁺ | 14800 |
| M ⁸⁺ - M ⁹⁺ | 16800 |
| M ⁹⁺ - M ¹⁰⁺ | 19700 |

Other Information

| | |
|---|-------|
| Enthalpy of Fusion/kJ mol ⁻¹ | 27.6 |
| Enthalpy of Vaporisation/kJ mol ⁻¹ | 589.9 |

Oxidation States

| | |
|--------|---|
| Main | Mo ^{VI} |
| Others | Mo ^{II} , Mo ^O , Mo ^I , Mo ^{II} , Mo ^{III} , Mo ^{IV} , Mo ^V |

Covalent Bonds/kJ mol⁻¹

Not applicable