

Ruthenium

Ru

General Information

Discovery

Ruthenium was discovered by J.A. Sniadecki in 1808 in Poland, but not recognised as an element. Klaus is generally recognised as the discoverer, as in 1844 he purified the metal from the impure oxide.

Appearance

Ruthenium is a hard, lustrous, white metal that does not tarnish at room temperature.

Source

Ruthenium is found as the free metal but also associated with other platinum metals in the mineral pentlandite, found in the USA, and pyroxinite, found in South Africa. Commercially, it is obtained from the wastes of nickel refining.

Uses

Ruthenium is one of the most effective hardeners for platinum and palladium, and is alloyed with these metals to make electrical contacts for severe wear resistance. It is also a versatile catalyst, used to split hydrogen sulphide as one example.

Biological Role

Ruthenium has no known biological role. Ruthenium (IV) oxide is highly toxic.

General Information

Ruthenium is unaffected by air, water and acids but dissolves in molten alkali, and is attacked by halogens.

Physical Information

Atomic Number	44
Relative Atomic Mass (¹² C=12.000)	101.07
Melting Point/K	2583
Boiling Point/K	4173
Density/kg m ⁻³	12370 (293K)
Ground State Electron Configuration	[Kr]4d ⁷ 5s ¹
Electron Affinity (M-M ⁻)/kJ mol ⁻¹	146

Key Isotopes

Nuclide	⁹⁶ Ru	⁹⁷ Ru	⁹⁸ Ru	⁹⁹ Ru	¹⁰⁰ Ru	¹⁰¹ Ru
Atomic mass	95.91		97.91	98.91	99.90	100.9
Natural abundance	5.52%	0%	1.88%	12.7%	12.6%	17%
Half-life	stable	2.88 days	stable	stable	stable	stable
Nuclide	¹⁰² Ru	¹⁰³ Ru	¹⁰⁴ Ru	¹⁰⁶ Ru		
Atomic mass	101.9		103.91			
Natural abundance	31.6%	0%	18.7%	0%		
Half-life	stable	39.6 days	stable	367 days		

Ionisation Energies/kJ mol⁻¹

M - M ⁺	711
M ⁺ - M ²⁺	1617
M ²⁺ - M ³⁺	2747
M ³⁺ - M ⁴⁺	4500
M ⁴⁺ - M ⁵⁺	6100
M ⁵⁺ - M ⁶⁺	7800
M ⁶⁺ - M ⁷⁺	9600
M ⁷⁺ - M ⁸⁺	11500
M ⁸⁺ - M ⁹⁺	18700
M ⁹⁺ - M ¹⁰⁺	20900

Other Information

Enthalpy of Fusion/kJ mol ⁻¹	23.7
Enthalpy of Vaporisation/kJ mol ⁻¹	567
Oxidation States	
Main	Ru ^{III}
Others	Ru ^{-II} , Ru ^O , Ru ^I , Ru ^{II} , Ru ^{IV} , Ru ^V , Ru ^{VI} , Ru ^{VII} , Ru ^{VIII}
Covalent Bonds/kJ mol ⁻¹	
Not applicable	