

# Uranium

U

## ***General Information***

### **Discovery**

Uranium was discovered by M.H. Klaproth in 1789 in Berlin, Germany, and isolated by E.M. Péligot in Paris, France, in 1842.

### **Appearance**

Uranium is a radioactive, silvery metal.

### **Source**

Uranium occurs naturally in several minerals such as pitchblende, uraninite and carnotite. It is also found in phosphate rock and monazite sands. It can be prepared by reducing uranium halides with Group 1 or Group 2 metals, or by reducing uranium oxides with calcium or carbon at high temperatures.

### **Uses**

Uranium is of great importance as it provides us with nuclear fuel. Uranium-235 is the only naturally occurring fissionable fuel (can sustain a chain reaction) but is of very low abundance. However, in a breeder reactor uranium-238 can capture a neutron and undergo negative beta decay to become Plutonium-239. This synthetic, fissionable element can sustain a chain reaction and the resultant heat is used to create steam to work turbines and generate electrical power. Uranium is the major material from which other synthetic transuranium elements are made, and is also used to make isotopes for peaceful purposes, and to make nuclear weapons.

### **Biological Role**

Uranium has no known biological role. It is toxic due to its radioactivity.

### **General Information**

Uranium is malleable, ductile and tarnishes in air. It reacts with acids but not by alkalis. In a finely divided state it is pyrophoric.

## Physical Information

Atomic Number	92
Relative Atomic Mass ( $^{12}\text{C}=12.000$ )	238.03
Melting Point/K	1405
Boiling Point/K	4018
Density/kg m <sup>-3</sup>	18950 (293K)
Ground State Electron Configuration	[Rn]5f <sup>3</sup> 6d <sup>1</sup> 7s <sup>2</sup>

## Key Isotopes

Nuclide	<sup>234</sup> U	<sup>235</sup> U	<sup>236</sup> U	<sup>238</sup> U
Atomic mass	234.04	235.04	236.05	238.05
Natural abundance	0.005%	0.720%	0%	99.28%
Half-life	2.47x10 <sup>5</sup> yrs	7x10 <sup>8</sup> yrs	2.39x10 <sup>7</sup> yrs	4.51x10 <sup>9</sup> yrs

## Ionisation Energies/kJ mol<sup>-1</sup>

M - M <sup>+</sup>	584
M <sup>+</sup> - M <sup>2+</sup>	1420
M <sup>2+</sup> - M <sup>3+</sup>	
M <sup>3+</sup> - M <sup>4+</sup>	
M <sup>4+</sup> - M <sup>5+</sup>	
M <sup>5+</sup> - M <sup>6+</sup>	
M <sup>6+</sup> - M <sup>7+</sup>	
M <sup>7+</sup> - M <sup>8+</sup>	
M <sup>8+</sup> - M <sup>9+</sup>	
M <sup>9+</sup> - M <sup>10+</sup>	

## Other Information

Enthalpy of Fusion/kJ mol <sup>-1</sup>	15.5
Enthalpy of Vaporisation/kJ mol <sup>-1</sup>	417.1

### Oxidation States

Main	U <sup>+6</sup>
Others	U <sup>+2</sup> , U <sup>+3</sup> , U <sup>+4</sup> , U <sup>+5</sup>