

# Hafnium

**Hf**

## ***General Information***

### **Discovery**

Hafnium was discovered by D. Coster and G.C. von Hevesey in 1923 in Copenhagen, Denmark.

### **Appearance**

Hafnium is a lustrous, silvery, ductile metal.

### **Source**

Most zirconium minerals contain 1-5% hafnium, and the metal is prepared by reducing the tetrachloride with sodium or magnesium.

### **Uses**

Hafnium has a good thermal absorption cross-section for neutrons, so is used in control rods in nuclear reactors. It has been successfully alloyed with several metals including iron, titanium and niobium. It is also used in gas-filled and incandescent lights.

### **Biological Role**

Hafnium has no known biological role, and is non-toxic.

### **General Information**

Hafnium resists corrosion due to an oxide film, but powdered hafnium will burn in air. It is unaffected by all acids except hydrogen fluoride, and also all alkalis. At high temperatures it reacts with oxygen, nitrogen, carbon, boron, sulphur and silicon.

## Physical Information

Atomic Number	72
Relative Atomic Mass ( $^{12}\text{C}=12.000$ )	178.49
Melting Point/K	2503
Boiling Point/K	5470
Density/kg m <sup>-3</sup>	13310 (293K)
Ground State Electron Configuration	[Xe]4f <sup>14</sup> 5d <sup>2</sup> 6s <sup>2</sup>
Electron Affinity (M-M <sup>-</sup> )/kJ mol <sup>-1</sup>	-61

## Key Isotopes

Nuclide	<sup>172</sup> Hf	<sup>174</sup> Hf	<sup>175</sup> Hf	<sup>176</sup> Hf	<sup>177</sup> Hf	<sup>178</sup> Hf
Atomic mass		173.9		175.9	176.9	177.9
Natural abundance	0%	0.2%	0%	5.2%	18.6%	27.1%
Half-life	5 yrs	2x10 <sup>15</sup> yrs	70 days	stable	stable	stable
Nuclide	<sup>179</sup> Hf	<sup>180</sup> Hf	<sup>181</sup> Hf	<sup>182</sup> Hf		
Atomic mass	178.9	179.9				
Natural abundance	13.7%	35.2%	0%	0%		
Half-life	stable	stable	42.5 days	9x10 <sup>6</sup> yrs		

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

M - M <sup>+</sup>	642
M <sup>+</sup> - M <sup>2+</sup>	1440
M <sup>2+</sup> - M <sup>3+</sup>	2250
M <sup>3+</sup> - M <sup>4+</sup>	3216
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>	25.5
Enthalpy of Vaporisation/kJ mol <sup>-1</sup>	570.7

### Oxidation States

Main	Hf <sup>IV</sup>
Others	Hf <sup>I</sup> , Hf <sup>II</sup> , Hf <sup>III</sup>

### Covalent Bonds/kJ mol<sup>-1</sup>

Not applicable