Essential Spectroscopy Reference

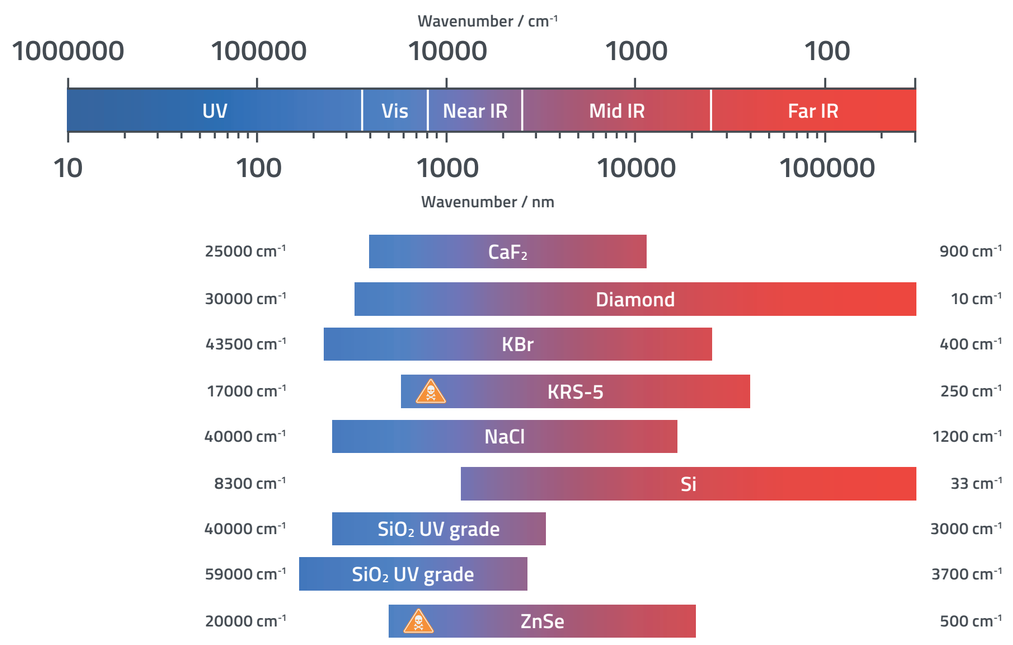
Atomic Number	Symbol	Name	Electronic Configuration	Atomic Mass
6	C	Carbon	$[He]2s^2 2p^2$	12.011

Alkali Metals	Gas
Alkaline Metals	Liquid
Transition Metals	Solid
Other Metals	Radioactive*
Metalloids	Synthetic**
Non-Metals	(Longest Lived Isotope)
Halogens	
Noble Gasses	
Rare Earth Metals	

1 H Hydrogen $1s^1$ 1.008																	2 He Helium $1s^2$ 4.0026
3 Li Lithium $[He]2s^1$ 6.968	4 Be Beryllium $[He]2s^2$ 9.012											5 B Boron $[He]2s^2 2p^1$ 10.814	6 C Carbon $[He]2s^2 2p^2$ 12.011	7 N Nitrogen $[He]2s^2 2p^3$ 14.007	8 O Oxygen $[He]2s^2 2p^4$ 15.999	9 F Fluorine $[He]2s^2 2p^5$ 18.998	10 Ne Neon $[He]2s^2 2p^6$ 20.18
11 Na Sodium $[Ne]3s^1$ 22.99	12 Mg Magnesium $[Ne]3s^2$ 24.306											13 Al Aluminum $[Ne]3s^2 3p^1$ 26.982	14 Si Silicon $[Ne]3s^2 3p^2$ 28.085	15 P Phosphorus $[Ne]3s^2 3p^3$ 30.974	16 S Sulfur $[Ne]3s^2 3p^4$ 32.068	17 Cl Chlorine $[Ne]3s^2 3p^5$ 35.452	18 Ar Argon $[Ne]3s^2 3p^6$ 39.948
19 K Potassium $[Ar]4s^1$ 39.098	20 Ca Calcium $[Ar]4s^2$ 40.078	21 Sc Scandium $[Ar]3d^1 4s^2$ 44.956	22 Ti Titanium $[Ar]3d^2 4s^2$ 47.867	23 V Vanadium $[Ar]3d^3 4s^2$ 50.942	24 Cr Chromium $[Ar]3d^5 4s^1$ 51.996	25 Mn Manganese $[Ar]3d^5 4s^2$ 54.938	26 Fe Iron $[Ar]3d^6 4s^2$ 55.845	27 Co Cobalt $[Ar]3d^7 4s^2$ 58.933	28 Ni Nickel $[Ar]3d^8 4s^2$ 58.693	29 Cu Copper $[Ar]3d^{10} 4s^1$ 63.546	30 Zn Zinc $[Ar]3d^{10} 4s^2$ 65.382	31 Ga Gallium $[Ar]3d^{10} 4s^2 4p^1$ 69.723	32 Ge Germanium $[Ar]3d^{10} 4s^2 4p^2$ 72.63	33 As Arsenic $[Ar]3d^{10} 4s^2 4p^3$ 74.922	34 Se Selenium $[Ar]3d^{10} 4s^2 4p^4$ 78.971	35 Br Bromine $[Ar]3d^{10} 4s^2 4p^5$ 79.904	36 Kr Krypton $[Ar]3d^{10} 4s^2 4p^6$ 83.798
37 Rb Rubidium $[Kr]5s^1$ 85.468	38 Sr Strontium $[Kr]5s^2$ 87.62	39 Y Yttrium $[Kr]4d^1 5s^2$ 88.906	40 Zr Zirconium $[Kr]4d^2 5s^2$ 91.224	41 Nb Niobium $[Kr]4d^4 5s^1$ 92.906	42 Mo Molybdenum $[Kr]4d^5 5s^1$ 95.951	43 Tc* Technetium $[Kr]4d^5 5s^2$ (98)	44 Ru Ruthenium $[Kr]4d^7 5s^1$ 101.072	45 Rh Rhodium $[Kr]4d^8 5s^1$ 102.906	46 Pd Palladium $[Kr]4d^{10}$ 106.421	47 Ag Silver $[Kr]4d^{10} 5s^1$ 107.868	48 Cd Cadmium $[Kr]4d^{10} 5s^2$ 112.414	49 In Indium $[Kr]4d^{10} 5s^2 5p^1$ 114.818	50 Sn Tin $[Kr]4d^{10} 5s^2 5p^2$ 118.71	51 Sb Antimony $[Kr]4d^{10} 5s^2 5p^3$ 121.76	52 Te Tellurium $[Kr]4d^{10} 5s^2 5p^4$ 127.6	53 I Iodine $[Kr]4d^{10} 5s^2 5p^5$ 126.904	54 Xe Xenon $[Kr]4d^{10} 5s^2 5p^6$ 131.293
55 Cs Cesium $[Xe]6s^1$ 132.905	56 Ba Barium $[Xe]6s^2$ 137.327		72 Hf Hafnium $[Xe]4f^{14} 5d^2 6s^2$ 178.49	73 Ta Tantalum $[Xe]4f^{14} 5d^3 6s^2$ 180.948	74 W Tungsten $[Xe]4f^{14} 5d^4 6s^2$ 183.84	75 Re Rhenium $[Xe]4f^{14} 5d^5 6s^2$ 186.207	76 Os Osmium $[Xe]4f^{14} 5d^6 6s^2$ 190.233	77 Ir Iridium $[Xe]4f^{14} 5d^7 6s^2$ 192.217	78 Pt Platinum $[Xe]4f^{14} 5d^9 6s^1$ 195.084	79 Au Gold $[Xe]4f^{14} 5d^{10} 6s^1$ 196.967	80 Hg Mercury $[Xe]4f^{14} 5d^{10} 6s^2$ 200.592	81 Tl Thallium $[Xe]4f^{14} 5d^{10} 6s^2 6p^1$ 204.384	82 Pb Lead $[Xe]4f^{14} 5d^{10} 6s^2 6p^2$ 207.21	83 Bi Bismuth $[Xe]4f^{14} 5d^{10} 6s^2 6p^3$ 208.98	84 Po* Polonium $[Xe]4f^{14} 5d^{10} 6s^2 6p^4$ (209)	85 At* Astatine $[Xe]4f^{14} 5d^{10} 6s^2 6p^5$ (210)	86 Rn* Radon $[Xe]4f^{14} 5d^{10} 6s^2 6p^6$ (222)
87 Fr* Francium $[Rn]7s^1$ (223)	88 Ra* Radium $[Rn]7s^2$ (226)		104 Rf** Rutherfordium $[Rn]5f^{14} 6d^2 7s^2$ (267)	105 Db** Dubnium $[Rn]5f^{14} 6d^3 7s^2$ (268)	106 Sg** Seaborgium $[Rn]5f^{14} 6d^4 7s^2$ (269)	107 Bh** Bohrium $[Rn]5f^{14} 6d^5 7s^2$ (270)	108 Hs** Hassium $[Rn]5f^{14} 6d^6 7s^2$ (277)	109 Mt** Meitnerium $[Rn]5f^{14} 6d^7 7s^2$ (278)	110 Ds** Darmstadtium $[Rn]5f^{14} 6d^9 7s^1$ (281)	111 Rg** Roentgenium $[Rn]5f^{14} 6d^{10} 7s^1$ (282)	112 Cn** Copernicium $[Rn]5f^{14} 6d^{10} 7s^2$ (285)	113 Nh** Nihonium $[Rn]5f^{14} 6d^{10} 7s^2 7p^1$ (286)	114 Fl** Flerovium $[Rn]5f^{14} 6d^{10} 7s^2 7p^2$ (289)	115 Mc** Moscovium $[Rn]5f^{14} 6d^{10} 7s^2 7p^3$ (290)	116 Lv** Livermorium $[Rn]5f^{14} 6d^{10} 7s^2 7p^4$ (293)	117 Ts** Tennessine $[Rn]5f^{14} 6d^{10} 7s^2 7p^5$ (294)	118 Og** Oganesson $[Rn]5f^{14} 6d^{10} 7s^2 7p^6$ (294)

Lanthanides	57 La Lanthanum $[Xe]5d^1 6s^2$ 138.905	58 Ce Cerium $[Xe]4f^1 5d^1 6s^2$ 140.116	59 Pr Praseodymium $[Xe]4f^3 6s^2$ 140.908	60 Nd Neodymium $[Xe]4f^4 6s^2$ 144.242	61 Pm* Promethium $[Xe]4f^5 6s^2$ (145)	62 Sm Samarium $[Xe]4f^6 6s^2$ 150.362	63 Eu Europium $[Xe]4f^7 6s^2$ 151.964	64 Gd Gadolinium $[Xe]4f^7 5d^1 6s^2$ 157.253	65 Tb Terbium $[Xe]4f^9 6s^2$ 158.925	66 Dy Dysprosium $[Xe]4f^{10} 6s^2$ 162.5	67 Ho Holmium $[Xe]4f^{11} 6s^2$ 164.93	68 Er Erbium $[Xe]4f^{12} 6s^2$ 167.259	69 Tm Thulium $[Xe]4f^{13} 6s^2$ 168.934	70 Yb Ytterbium $[Xe]4f^{14} 6s^2$ 173.054	71 Lu Lutetium $[Xe]4f^{14} 5d^1 6s^2$ 174.967
Actinides	89 Ac* Actinium $[Rn]6d^1 7s^2$ (227)	90 Th* Thorium $[Rn]6d^2 7s^2$ 232.038	91 Pa* Protactinium $[Rn]5f^2 6d^1 7s^2$ 231.036	92 U* Uranium $[Rn]5f^3 6d^1 7s^2$ 238.03	93 Np* Neptunium $[Rn]5f^4 6d^1 7s^2$ (237)	94 Pu* Plutonium $[Rn]5f^6 7s^2$ (244)	95 Am* Americium $[Rn]5f^7 7s^2$ (243)	96 Cm** Curium $[Rn]5f^7 6d^1 7s^2$ (247)	97 Bk** Berkelium $[Rn]5f^9 7s^2$ (247)	98 Cf** Californium $[Rn]5f^{10} 7s^2$ (251)	99 Es** Einsteinium $[Rn]5f^{11} 7s^2$ (252)	100 Fm** Fermium $[Rn]5f^{12} 7s^2$ (257)	101 Md** Mendelevium $[Rn]5f^{13} 7s^2$ (258)	102 No** Nobelium $[Rn]5f^{14} 7s^2$ (259)	103 Lr** Lawrencium $[Rn]5f^{14} 7s^2 7p^1$ (266)

Common Window/ATR Crystal Guide



Diamond	Notes
CaF_2	Insoluble in water, resists most acids and alkalis. Soluble in ammonium salts and attacked by HNO_3. Its high mechanical strength makes it particularly useful for high pressure work. Sensitive to mechanical and thermal shock. Does not fog.
Diamond	Very hard and extremely chemically resistant. A diamond window is often chosen for high pressure applications. Excellent for ATR work. Has a strong phonon band between 1800–2700 cm^{-1}.
KBr	Hygroscopic material similar to NaCl. Soluble in water, glycerine and alcohols. Slightly soluble in ether. Fairly good resistance to mechanical and thermal shock.
KRS-5	Extremely toxic including by skin contact—avoid contact with bare skin. This material is a mixture of Thallium Bromide and Thallium Iodide salts. Orange/red in colour. Slightly soluble in water, soluble in bases, but not soluble in acids.
NaCl	Soluble in water and glycerine. Slightly soluble in alcohols. Fair resistance to mechanical and thermal shock and can be easily polished.
Si	Very hard, but brittle and relatively inert material. Is attacked by a combination of HF and HNO_3. Withstands thermal shock. Useful for Far IR. Has a strong phonon band between 630–590 cm^{-1}.
SiO_2	Resistant to acids and alkalis and unaffected by most solvents.
ZnSe	Toxic, hard and brittle material. Amber/yellow in colour. Insoluble in water, but attacked by strong acids (pH<4) and bases (pH>11) producing toxic gases. Organic solvents have no effect. Ideal for ATR work.

IR Characteristic Group Frequencies

ν = Stretch	S = Strong	W = Weak
δ = Bend	M = Medium	B = Broad