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Energy table for EDS analysis

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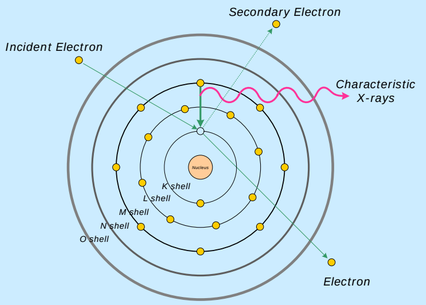
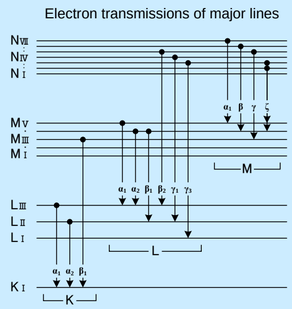
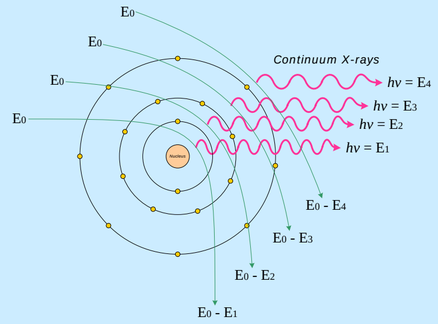
Characteristic X-rays





Continuum X-rays

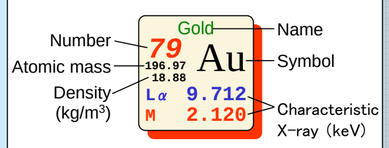


The electrons generated by the electron gun are accelerated and irradiate the sample. The electron has a kinetic energy proportional to the accelerating voltage. The kinetic energy dissipated within the sample generates characteristic signals from the specimen. The characteristic X-rays are the information used for EDS analysis.

If the incident electrons have sufficient acceleration and then have enough energy to strike an electron from the inner shell of the atom, it'll make an electron hole. An electron from the outer shell will fill up the hole and then, some characteristic X-rays will be emitted. The characteristic X-rays have different energy for each element, and the intensity will be proportional to the element concentration.

The continuum X-rays are emitted when the primary electrons are decelerated by the strong electric field existing close to atomic nucleus. The continuum X-rays have the energy of the kinetic energy lost during the deceleration. It will be observed as EDS spectrum background.

																Helium 2 He 4.00 0.19	
Hydrogen 1 H 1.01 0.08												Boron 5 B 10.81 2.54 Kα 0.183	Carbon 6 C 12.01 2.25 * Kα 0.277	Nitrogen 7 N 14.01 1.14 Kα 0.392	Oxygen 8 O 16.00 1.57 Kα 0.525	Fluorine 9 F 19.00 1.5 Kα 0.677	Neon 10 Ne 20.18 1.20 Kα 0.848
Lithium 3 Li 6.94 0.53	Beryllium 4 Be 9.01 1.85 Kα 0.110											Aluminium 13 Al 26.98 2.70 Kα 1.486	Silicon 14 Si 28.09 2.42 Kα 1.739	Phosphorus 15 P 30.97 1.83 * Kα 2.013	Sulphur 16 S 32.06 2.07 * Kα 2.307	Chlorine 17 Cl 35.45 2.2 Kα 2.621	Argon 18 Ar 39.95 1.65 Kα 2.957
Sodium 11 Na 22.99 0.97 Kα 1.041	Magnesium 12 Mg 24.31 1.74 Kα 1.253																
Potassium 19 K 39.10 0.87 Kα 3.312	Calcium 20 Ca 40.08 1.55 Kα 3.690	Scandium 21 Sc 44.96 2.99 Kα 4.088 Lα 0.395	Titanium 22 Ti 47.90 4.5 Kα 4.508 Lα 0.452	Vanadium 23 V 50.94 5.87 Kα 4.949 Lα 0.511	Chromium 24 Cr 52.00 7.14 Kα 5.411 Lα 0.573	Manganese 25 Mn 54.94 7.3 Kα 5.894 Lα 0.637	Iron 26 Fe 55.85 7.86 Kα 6.398 Lα 0.705	Cobalt 27 Co 58.93 8.71 Kα 6.924 Lα 0.776	Nickel 28 Ni 58.70 8.8 Kα 7.471 Lα 0.851	Copper 29 Cu 63.55 8.93 Kα 8.040 Lα 0.930	Zinc 30 Zn 65.38 6.92 Kα 8.630 Lα 1.012	Gallium 31 Ga 69.72 5.93 Kα 9.241 Lα 1.098	Germanium 32 Ge 72.59 5.46 Kα 9.874 Lα 1.188	Arsenic 33 As 74.92 5.73 Kα 10.530 Lα 1.282	Selenium 34 Se 78.96 4.82 Kα 11.207 Lα 1.379	Bromine 35 Br 79.90 4.2 Kα 11.907 Lα 1.480	Krypton 36 Kr 83.80 3.4 Kα 12.631 Lα 1.586
Rubidium 37 Rb 85.47 1.53 Kα 13.373 Lα 1.694	Strontium 38 Sr 87.62 2.60 Kα 14.140 Lα 1.806	Yttrium 39 Y 88.91 4.48 Kα 14.931 Lα 1.922	Zirconium 40 Zr 91.22 6.44 Kα 15.744 Lα 2.042	Niobium 41 Nb 92.91 8.4 Kα 16.581 Lα 2.166	Molybdenum 42 Mo 95.94 9.01 Kα 17.441 Lα 2.293	Technetium 43 Tc (97) Kα 18.325 Lα 2.424	Ruthenium 44 Ru 101.07 12.1 Kα 19.233 Lα 2.558	Rhodium 45 Rh 102.91 12.44 Lα 2.696	Palladium 46 Pd 106.4 12.16 Lα 2.838	Silver 47 Ag 107.87 10.49 Lα 2.984	Cadmium 48 Cd 112.40 8.65 Lα 3.133	Indium 49 In 114.82 7.28 Lα 3.286 M 0.368	Tin 50 Sn 118.69 7.30 * Lα 3.443 M 0.691	Antimony 51 Sb 121.75 6.62 Lα 3.604 M 0.733	Tellurium 52 Te 127.60 6.25 Lα 3.769 M 0.778	Iodine 53 I 126.90 4.94 Lα 3.937	Xenon 54 Xe 131.30 Lα 4.109
Cesium 55 Cs 132.91 1.87 Lα 4.286	Barium 56 Ba 137.34 3.5 Lα 4.465 M 0.972	Lanthanoid 57-71	Hafnium 72 Hf 178.49 13.3 Lα 7.898 M 1.644	Tantalum 73 Ta 180.95 16.6 Lα 8.145 M 1.709	Tungsten 74 W 183.85 19.3 Lα 8.396 M 1.774	Rhenium 75 Re 186.21 20.53 Lα 8.651 M 1.842	Osmium 76 Os 190.2 22.5 Lα 8.910 M 1.914	Iridium 77 Ir 192.22 22.42 Lα 9.174 M 1.977	Platinum 78 Pt 195.09 21.37 Lα 9.441 M 2.048	Gold 79 Au 196.97 18.88 Lα 9.712 M 2.120	Mercury 80 Hg 200.59 14.19 Lα 9.987 M 2.195	Thallium 81 Tl 204.37 11.86 Lα 10.267 M 2.267	Lead 82 Pb 207.2 11.34 Lα 10.550 M 2.342	Bismuth 83 Bi 208.98 9.78 Lα 10.837 M 2.419	Polonium 84 Po (209) Lα 11.129	Astatine 85 At (210) Lα 11.425	Radon 86 Rn (222) Lα 11.725
Francium 87 Fr (223) Lα 12.029	Radium 88 Ra 226.03 5 Lα 12.340	Actinoid 89-103	Actinium 89 Ac (227) 10.07 Lα 12.650	Thorium 90 Th 232.04 11.00 Lα 12.967 M 2.991	Protactinium 91 Pa 231.04 Lα 13.288 M 3.077	Uranium 92 U 238.03 18.7 Lα 13.612 M 3.164	Neptunium 93 Np 237.05 Lα 13.942 M 3.260	Plutonium 94 Pu (244) Lα 14.276 M 3.348	Americium 95 Am (243) Lα 14.615 M 3.437	Curium 96 Cm (247) Lα 14.953 M 3.539	Berkelium 97 Bk (247) Lα 15.304 M 3.634	Californium 98 Cf (251) Lα 15.652 M 3.731	Einsteinium 99 Es (254)	Fermium 100 Fm (257)	Mendelevium 101 Md (258)	Nobelium 102 No (255)	Lawrencium 103 Lr (262)
			Lanthanum 57 La 138.91 6.17 Lα 4.650 M 0.833	Cerium 58 Ce 140.12 6.66 Lα 4.839 M 0.883	Praseodymium 59 Pr 140.91 6.77 Lα 5.033 M 0.929	Neodymium 60 Nd 144.24 7.02 Lα 5.229 M 0.978	Prometium 61 Pm (145) Lα 5.432	Samarium 62 Sm 150.4 7.54 Lα 5.635 M 1.081	Europium 63 Eu 151.96 5.25 Lα 5.845 M 1.131	Gadolinium 64 Gd 157.25 7.90 Lα 6.056 M 1.185	Terbium 65 Tb 158.93 8.25 Lα 6.272 M 1.240	Dysprosium 66 Dy 162.50 8.56 Lα 6.494 M 1.293	Holmium 67 Ho 164.93 8.80 Lα 6.719 M 1.347	Erbium 68 Er 167.26 9.06 Lα 6.947 M 1.405	Thulium 69 Tm 168.93 9.32 Lα 7.179 M 1.462	Ytterbium 70 Yb 173.04 6.96 Lα 7.414 M 1.521	Lutetium 71 Lu 174.97 9.84 Lα 7.654 M 1.581



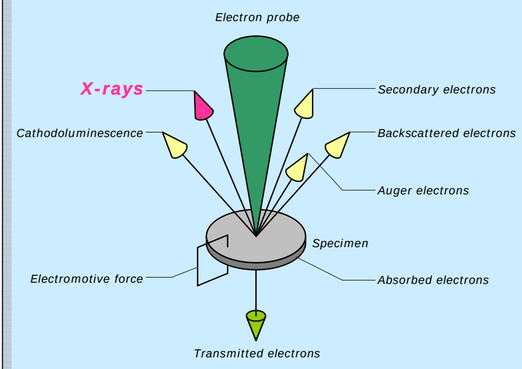
Note: Density
* 'C' as (graphite), 'P' as (white), 'S' as (alpha), 'Sn' as (white)

Minimum accelerating voltage

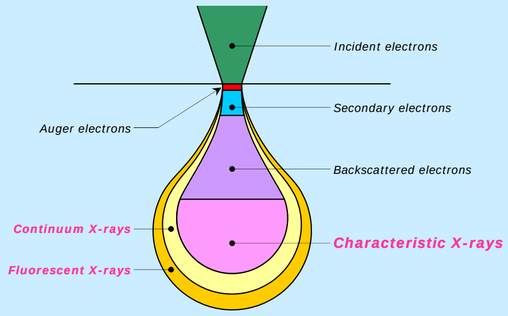
Unable to detect	5kV or higher
10kV or higher	15kV or higher

The colors mean to detect the characteristic X-ray of the lowest energy for each element.

Information from specimen



Generation depth and space resolution



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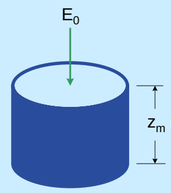
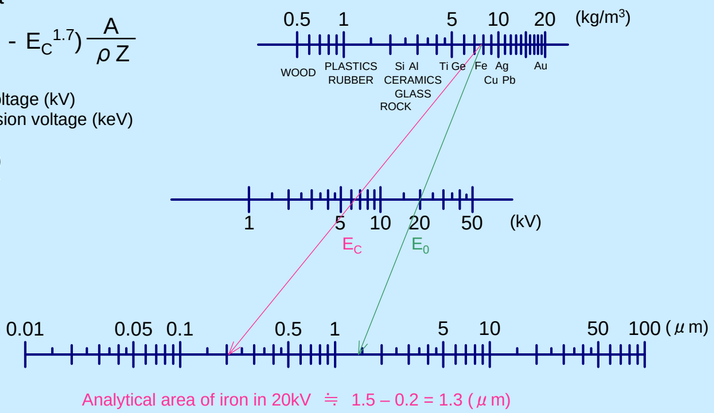
Analytical area

Castaing's formula

$$z_m = 0.033\,(E_0^{1.7} - E_C^{1.7})\,\frac{A}{\rho Z}$$

E_0 : Accelerating voltage (kV)
E_C : Minimum emission voltage (keV)
A : Atomic mass
ρ : Density (kg/m³)
Z : Atomic number





Analytical area of iron in 20kV ≒ 1.5 – 0.2 = 1.3 (μm)

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