

**Reference X-Ray Spectra  
of  
Metal Foils**

**Exafs  
Materials**

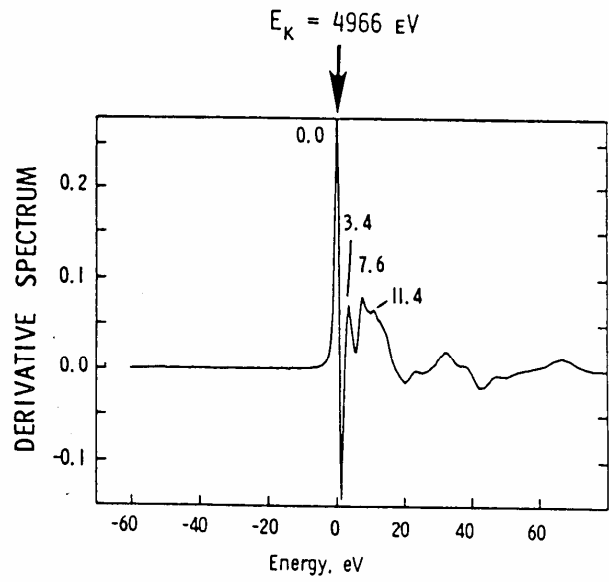
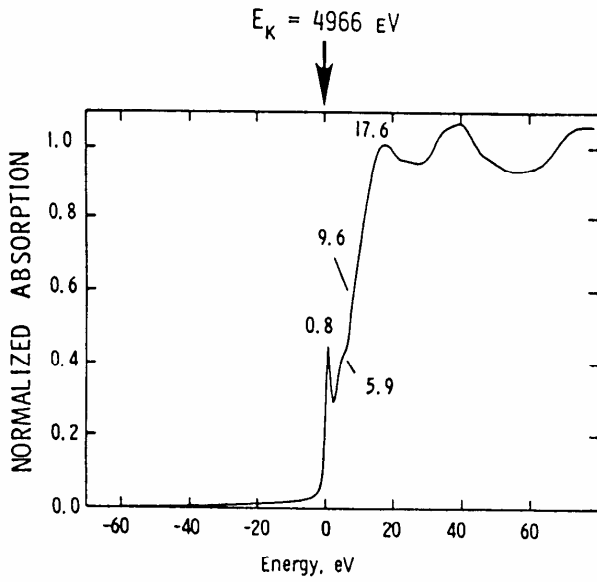
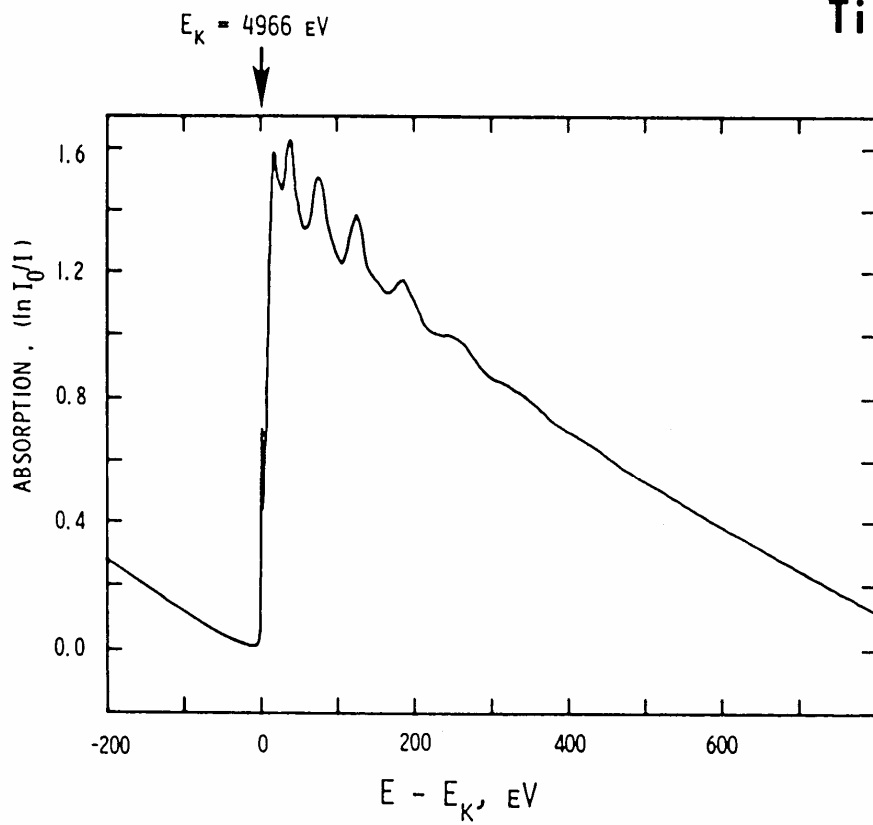
**871 El Cerro Blvd., Danville, CA 94526 USA**

**phone: (925) 838-7162  
fax: (925) 838-4630  
email: [exafs\\_materials@sbcglobal.net](mailto:exafs_materials@sbcglobal.net)**

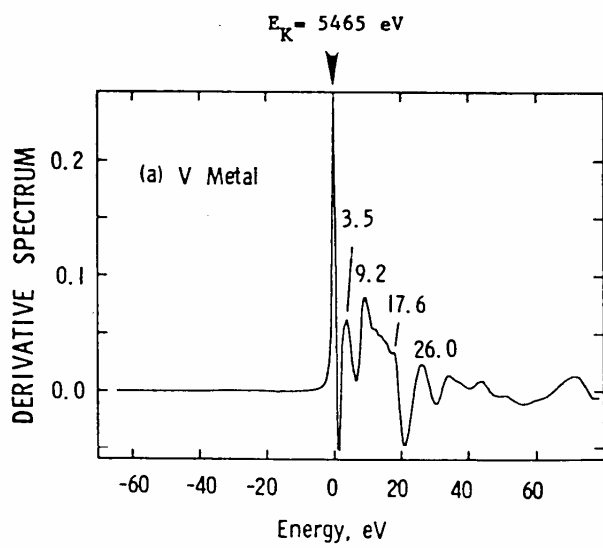
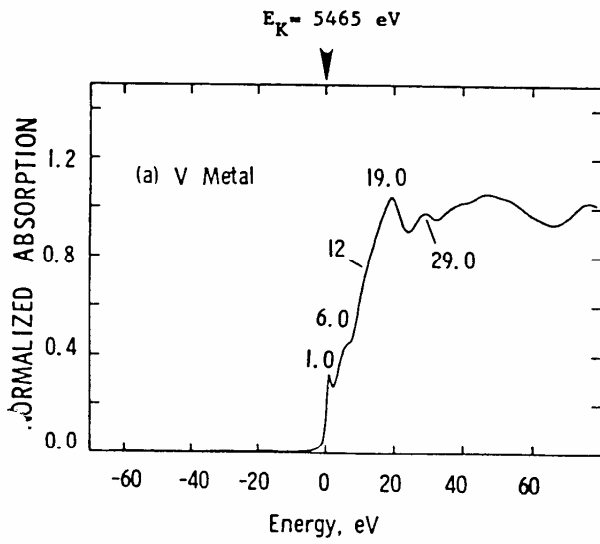
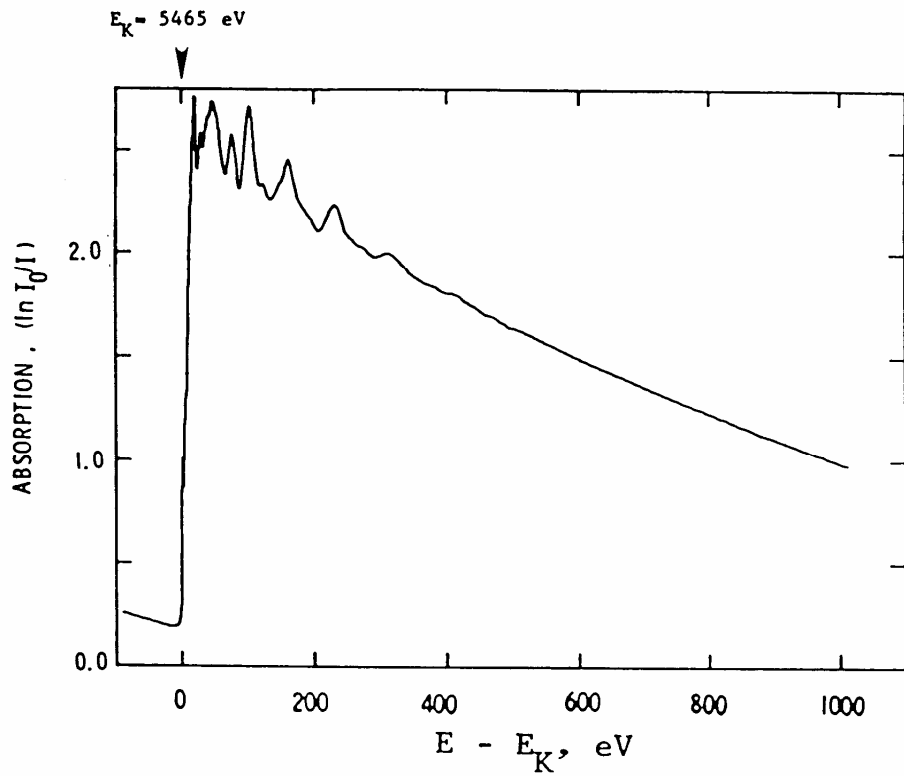
## ***Reference X-ray Spectra of Metal Foils***

The x-ray spectra compiled herein for the following metal foils were recorded at synchrotron beamlines 1-5, 4-2, 7-3 and 10-2 at Stanford Synchrotron Radiation Laboratory (SSRL) using double crystal Si(220) monochromators. The spectra for Ag, Pt and Au were recorded with a double crystal Si(111) monochromator on beamline X-11A at the National Synchrotron Light Source (NSLS) at Brookhaven. All spectra were taken at room temperature in the transmission geometry. In the region  $\pm 50$  eV about the absorption edge, each spectrum was scanned in step sizes 0.5 eV. An entrance slit with vertical opening of 1 mm and 0.5 mm was used for Si(220) and Si(111), respectively. The spectrometer resolution in each case was estimated to be 0.5 eV at the K-edge of Ti, and  $\sim 1.5$  eV at the K-edge of Cu. For each element, the tabulated edge energy (Bearden & Burr, *Rev. Mod. Phys.* 39, 125 (1967)) is defined operationally as the first inflection point in the derivative spectrum.

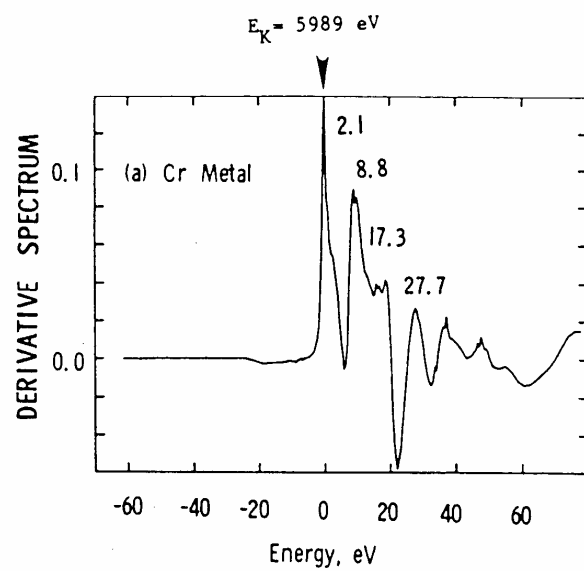
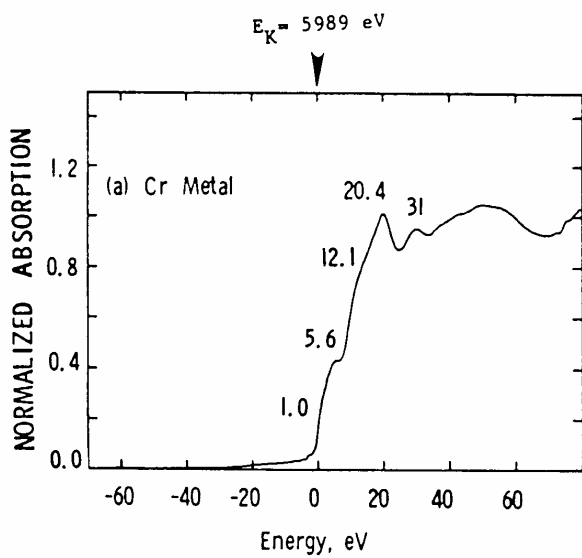
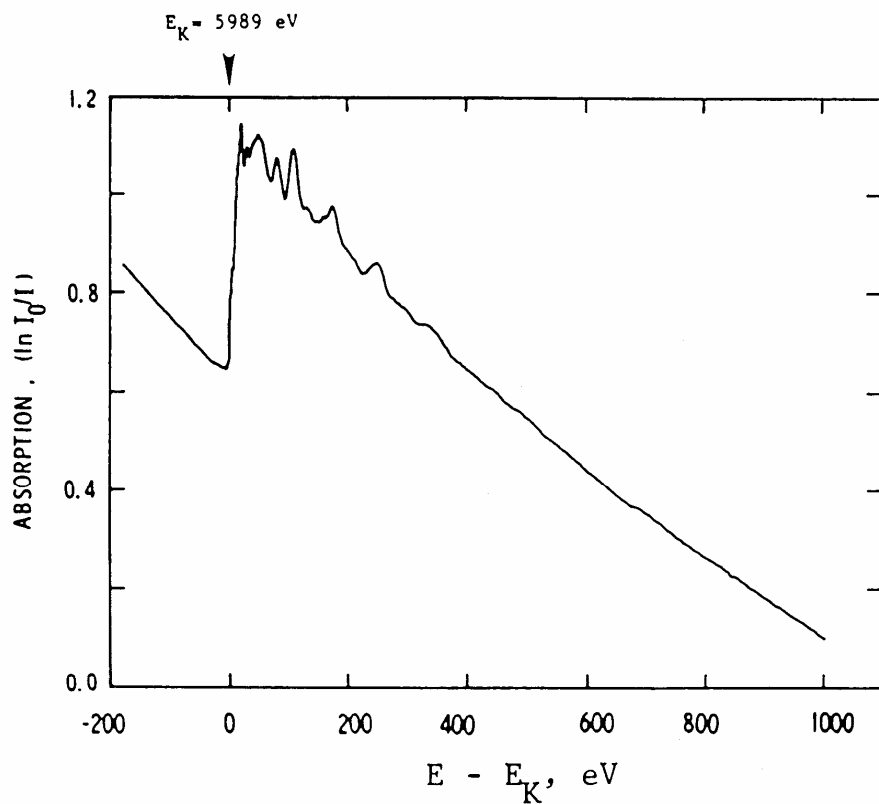
3d Metals: Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Se,  
4d Metals: Zr, Nb, Mo, Ru, Pd, Ag, Sn, Sb  
5d Metals: Ta, Pt, Au, Pb.



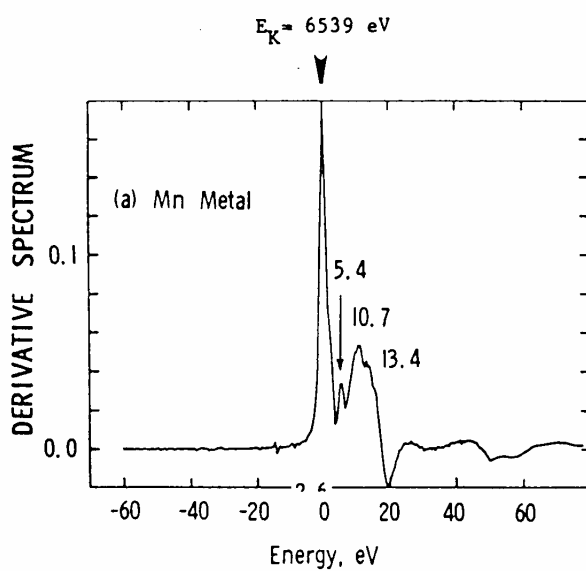
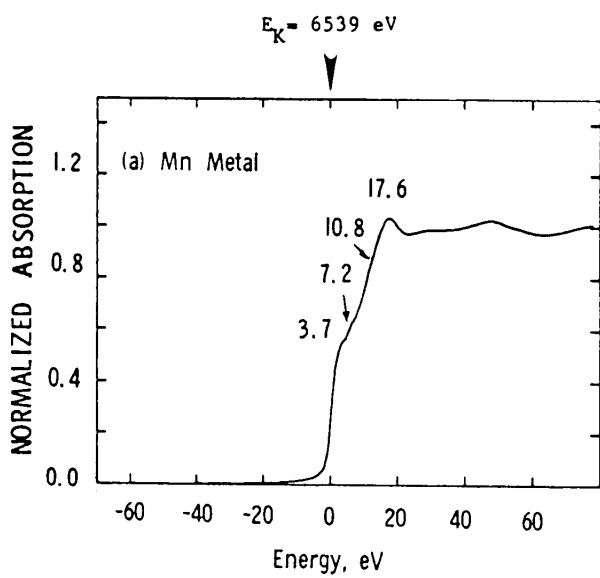
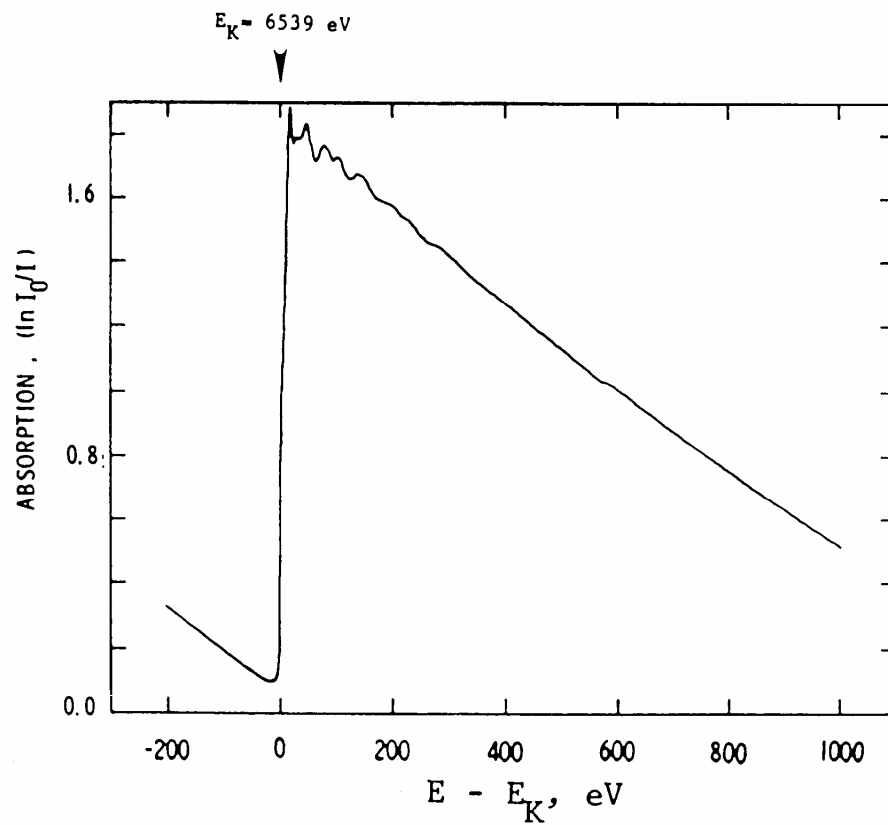
V



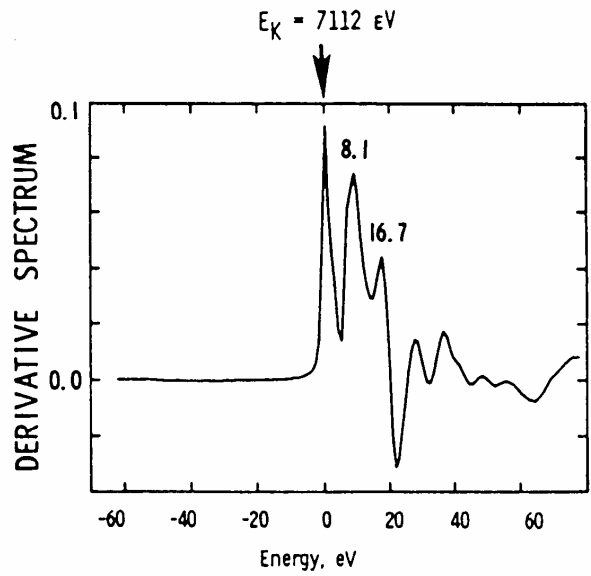
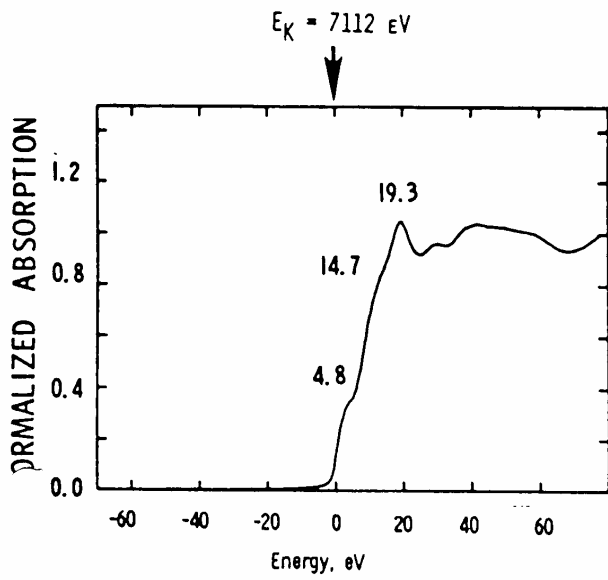
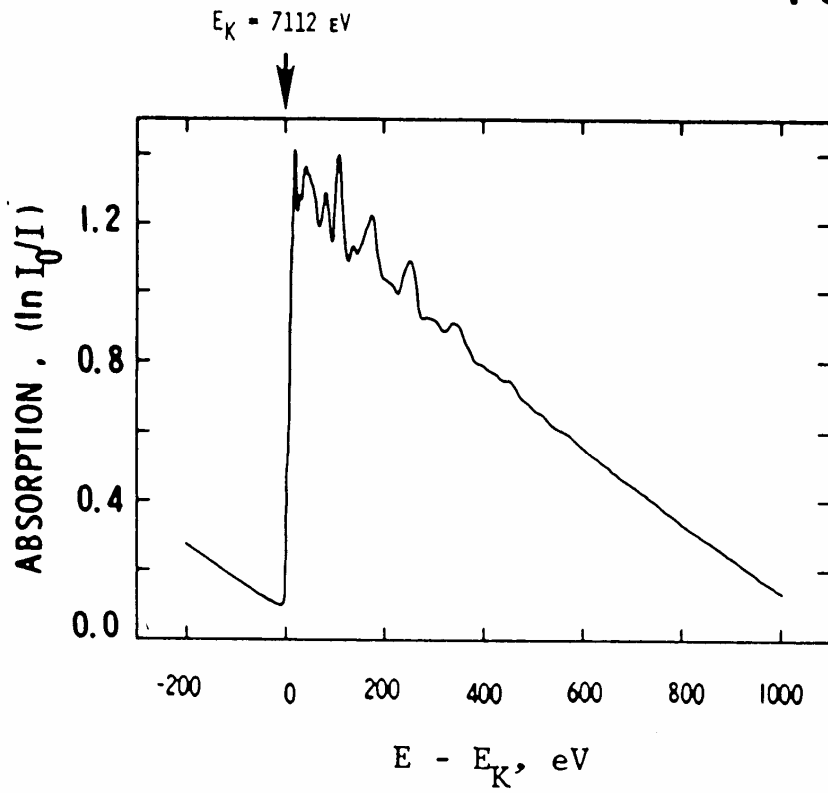
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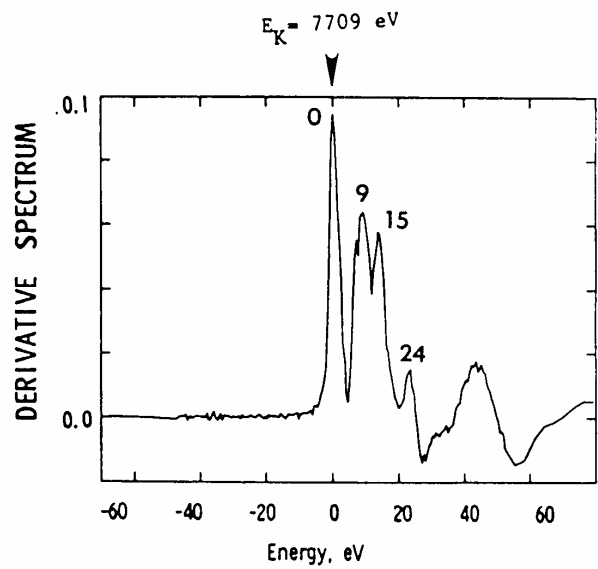
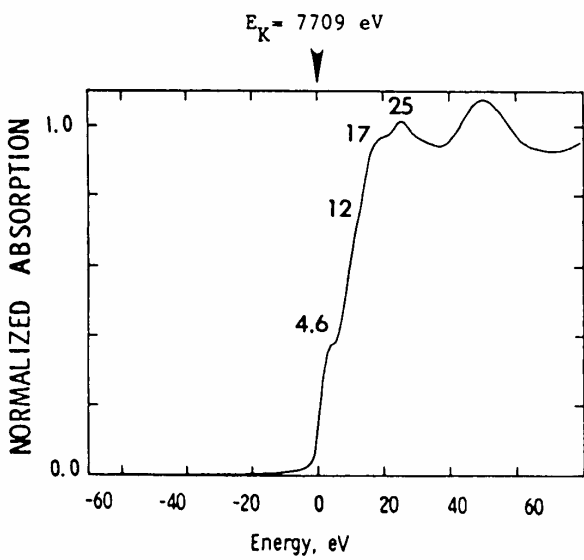
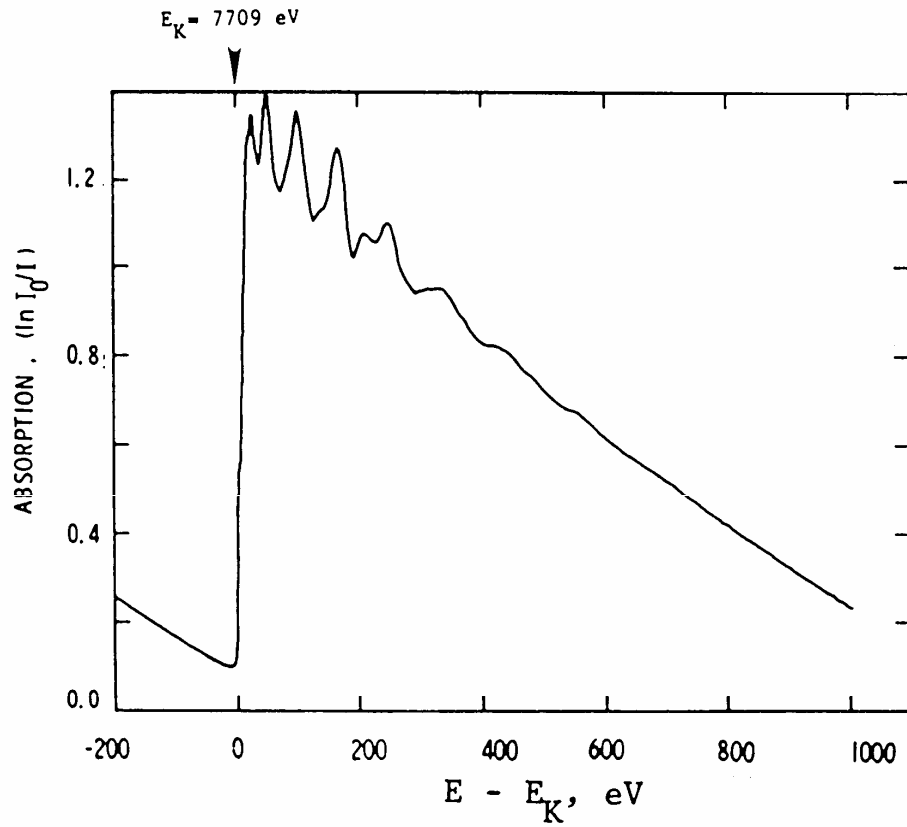
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Fe

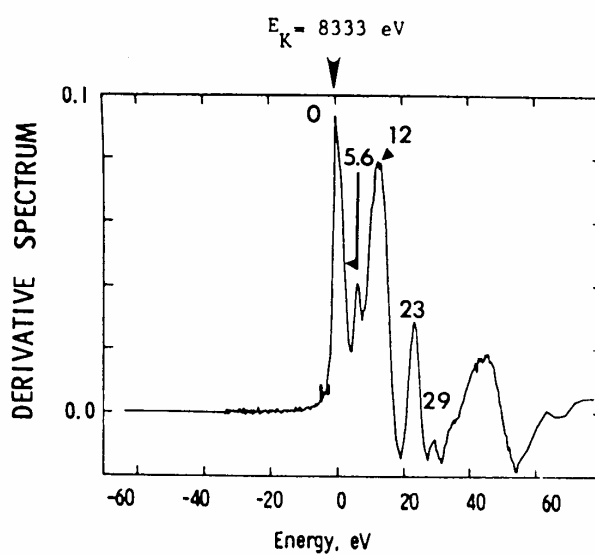
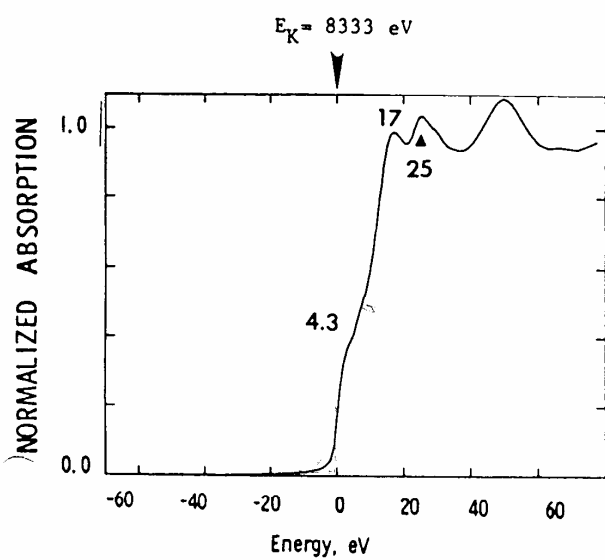
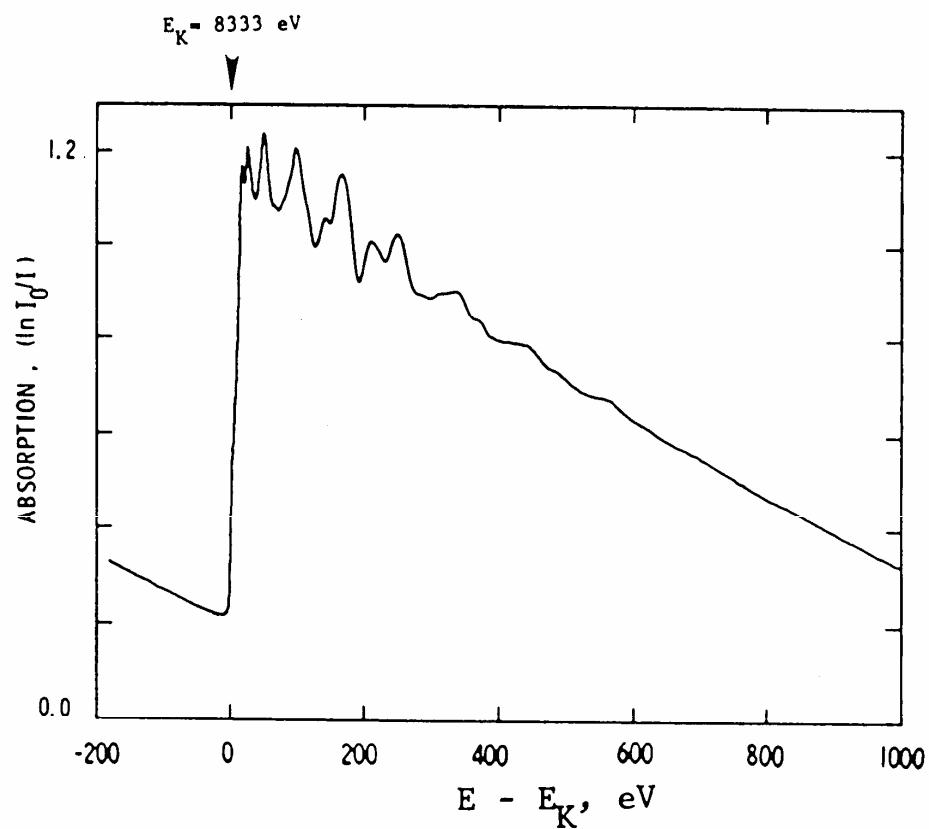


Co

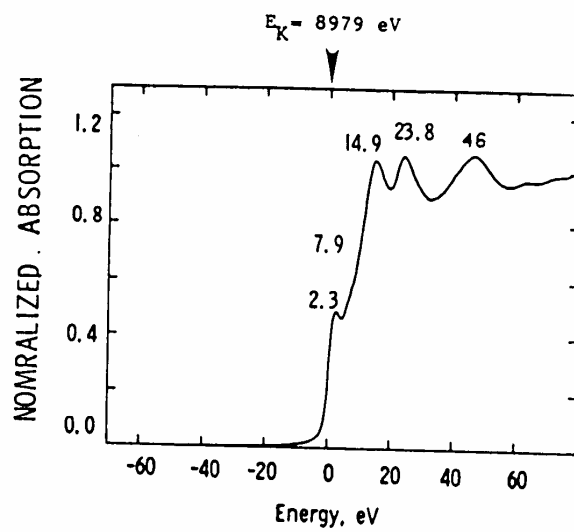
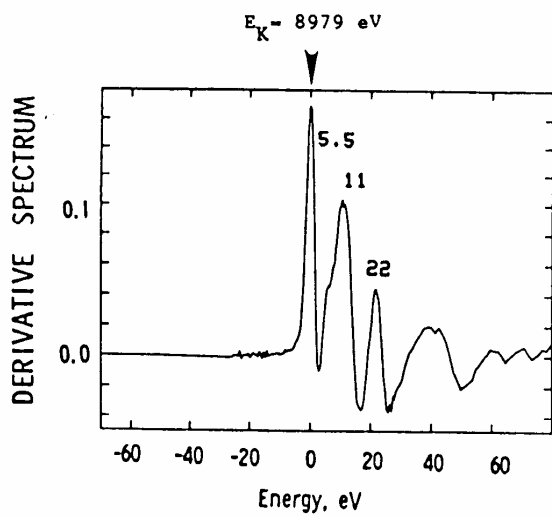
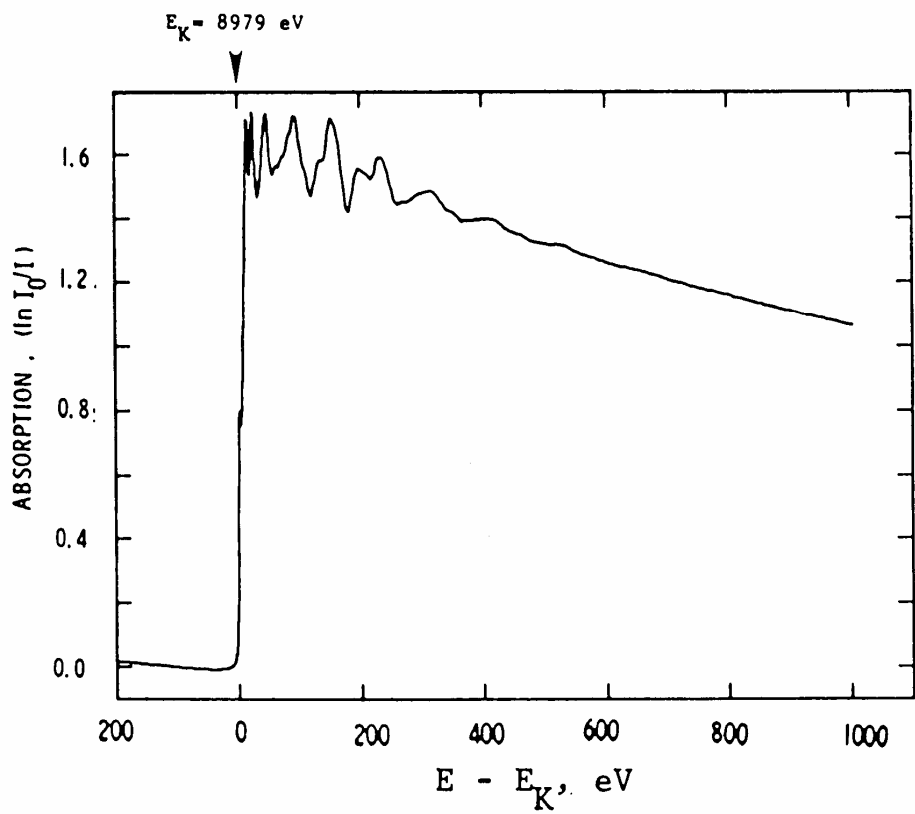




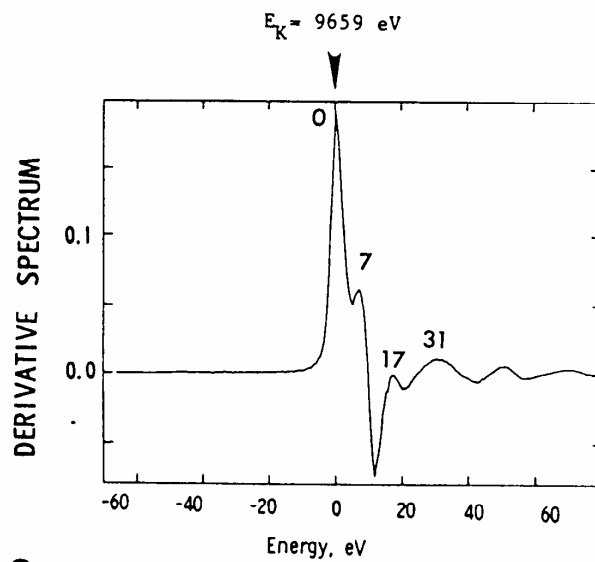
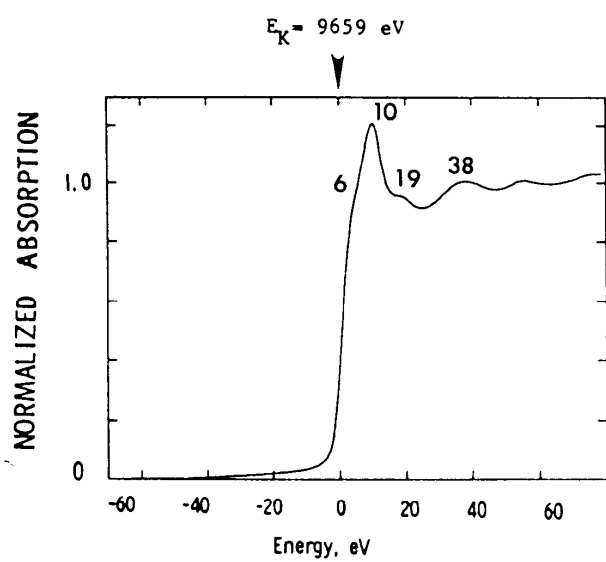
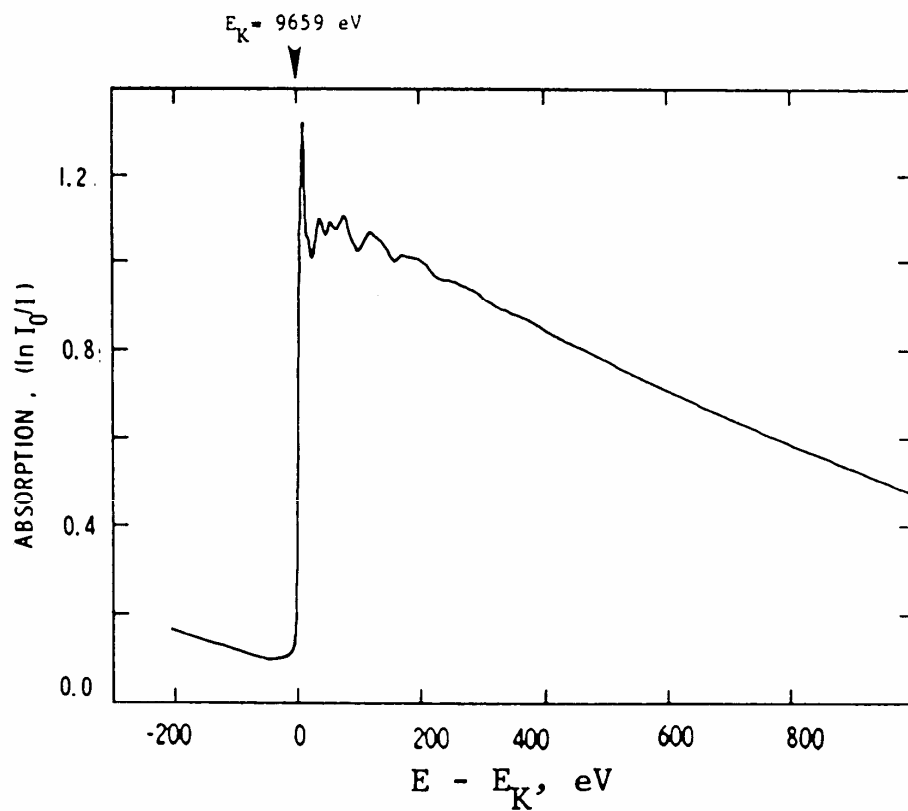
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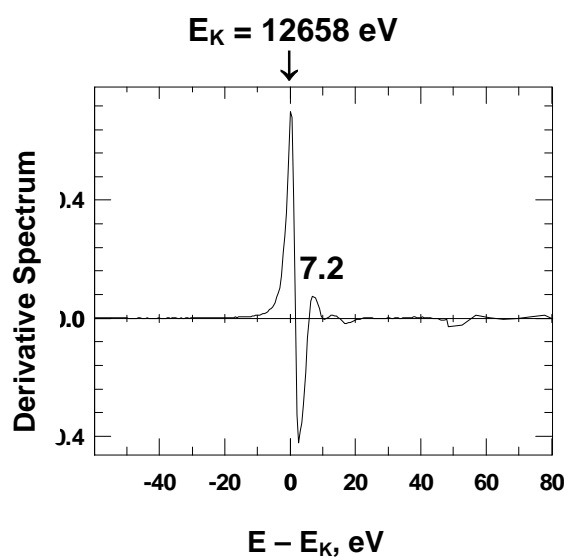
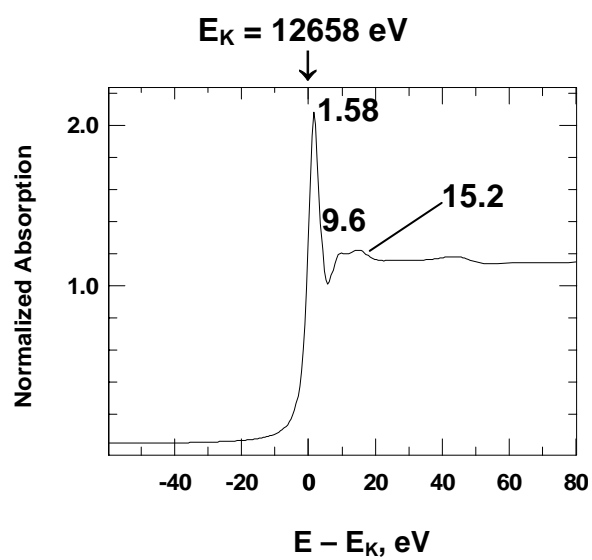
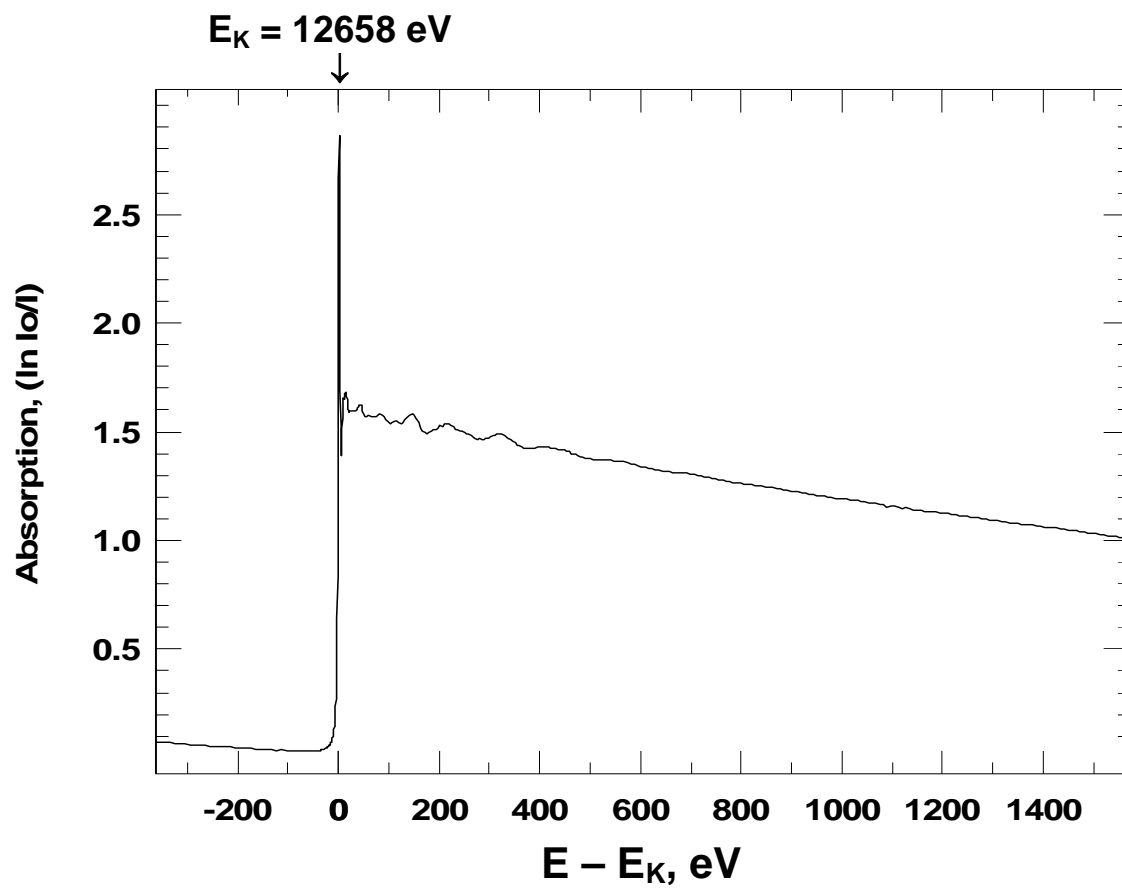
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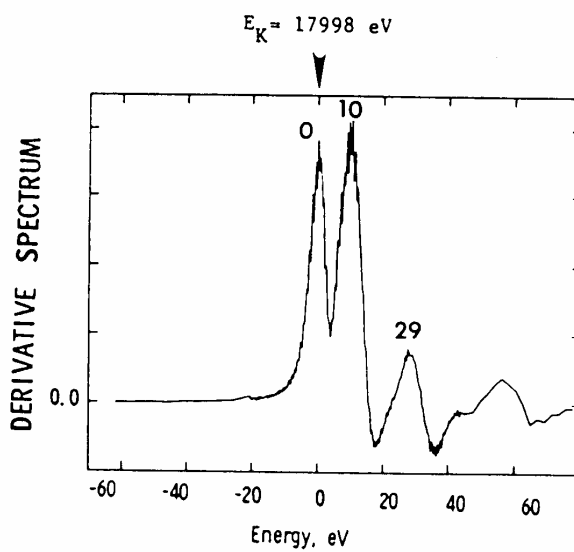
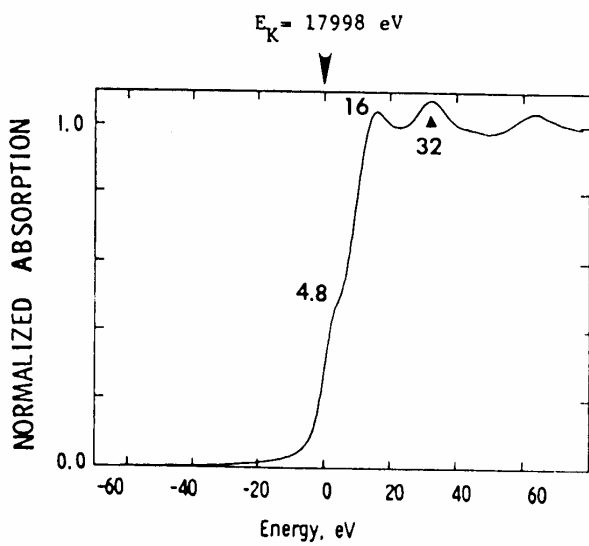
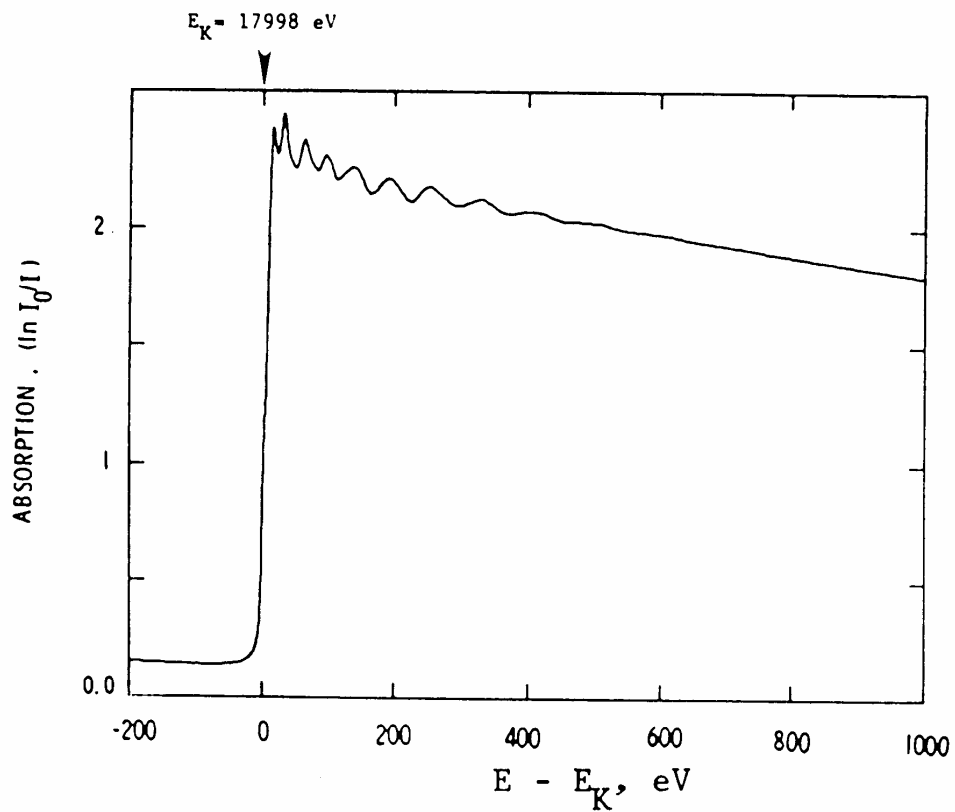
Zn



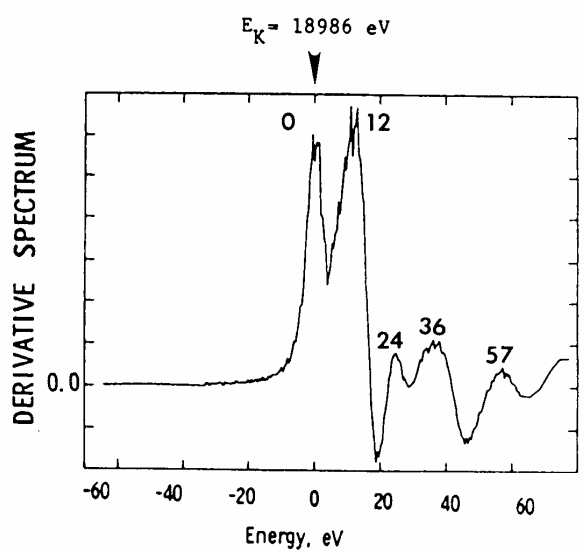
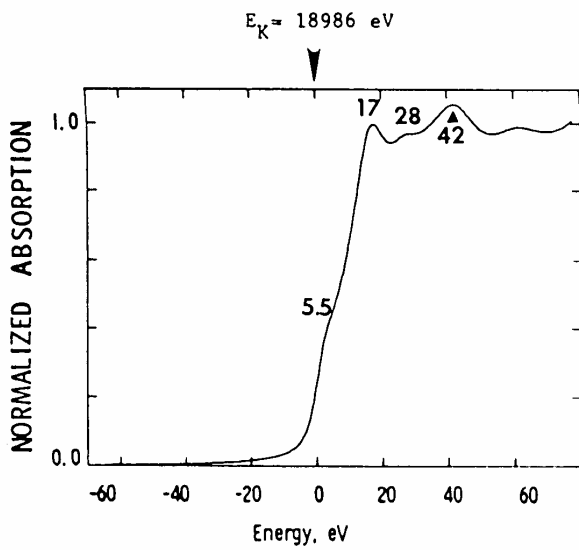
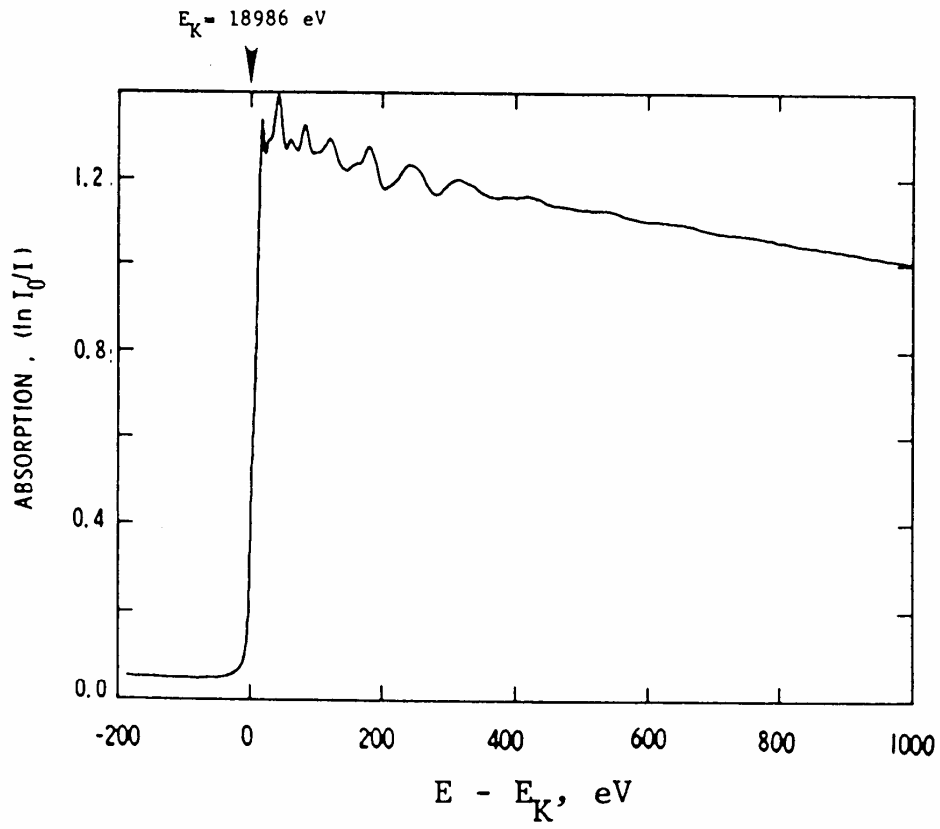
Se



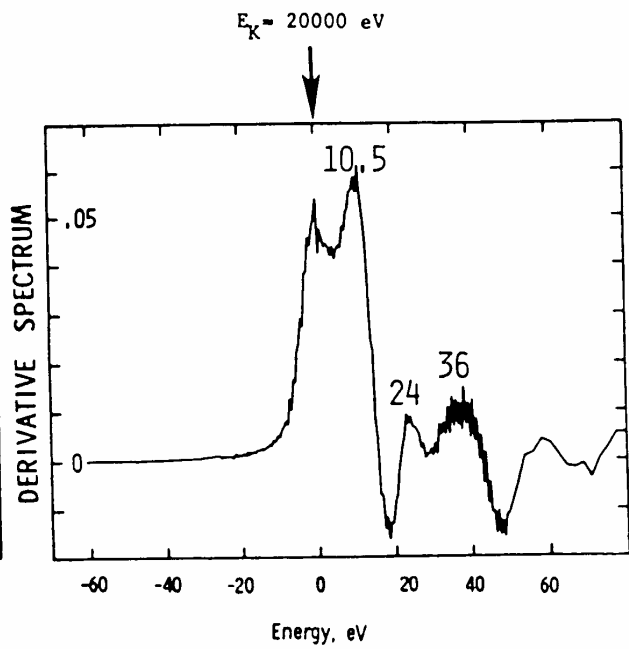
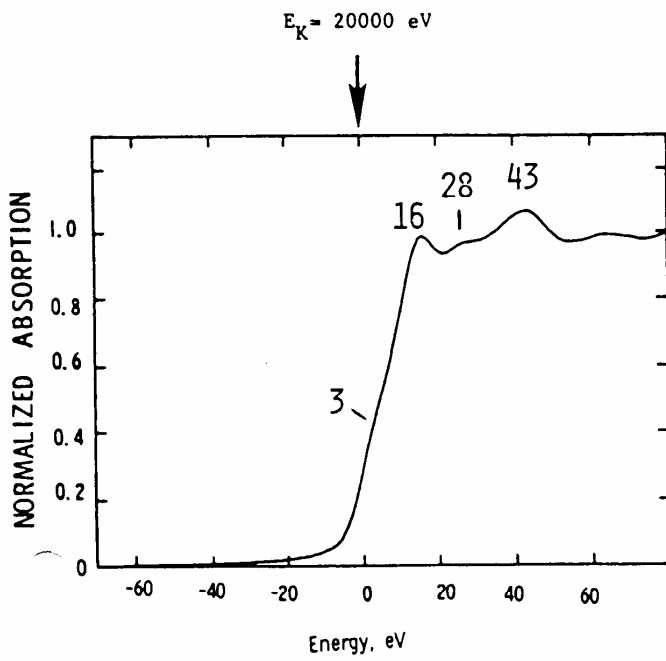
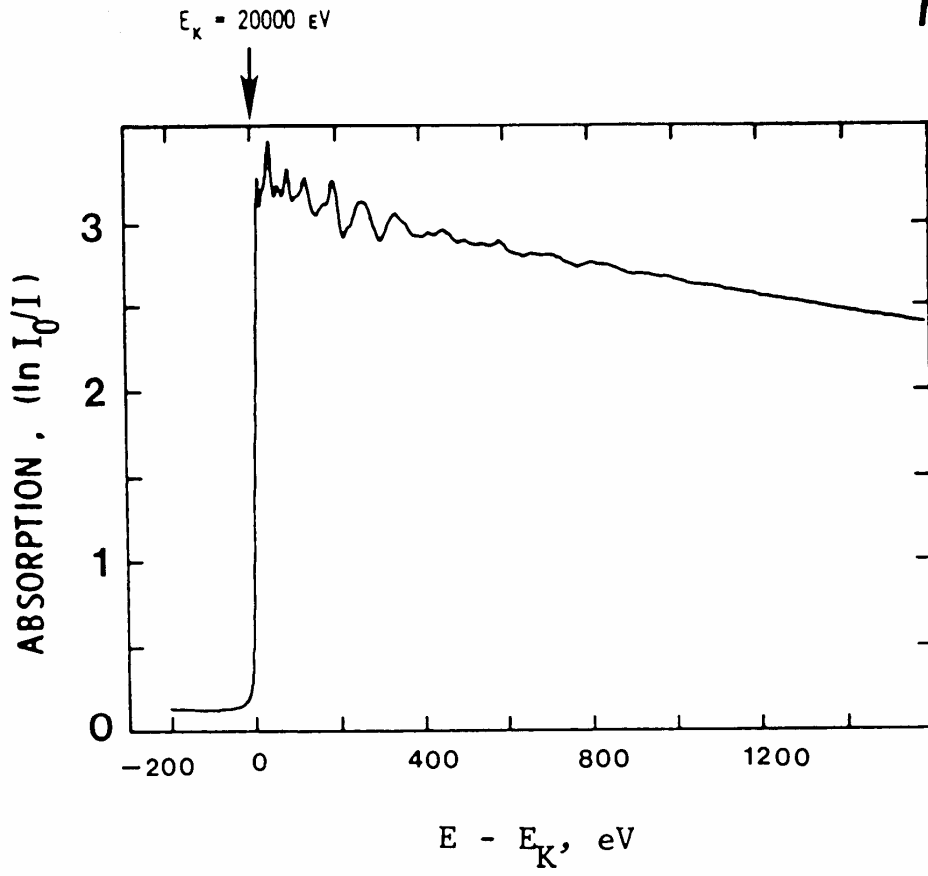
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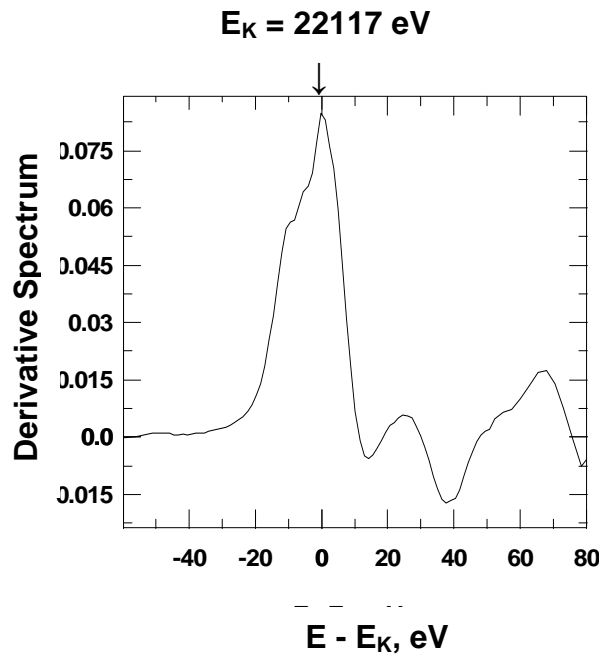
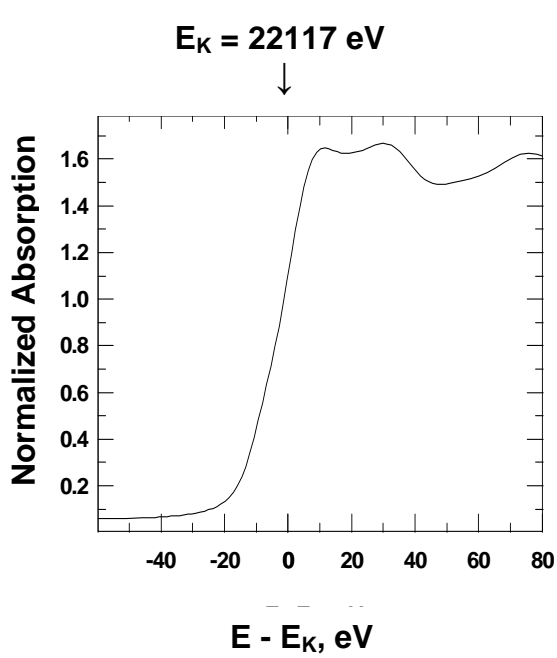
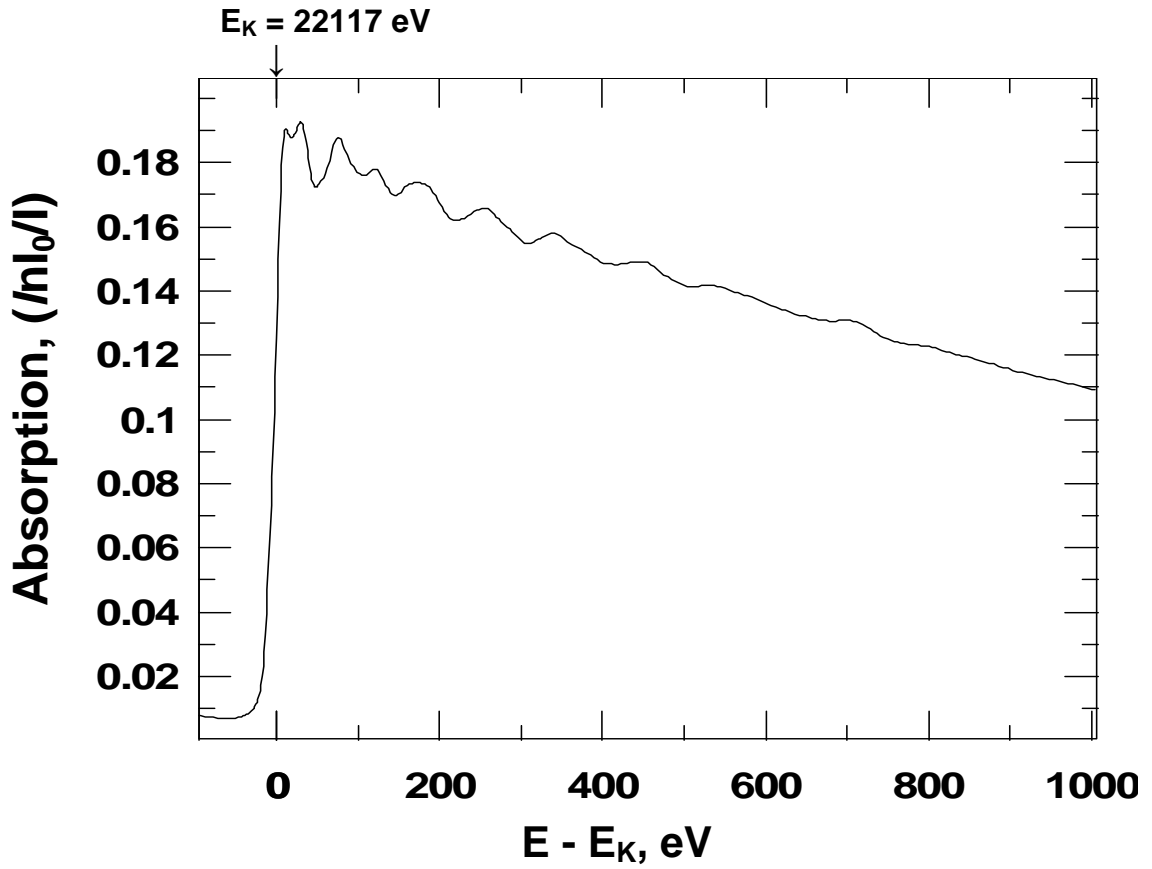
Nb



Mo



Ru

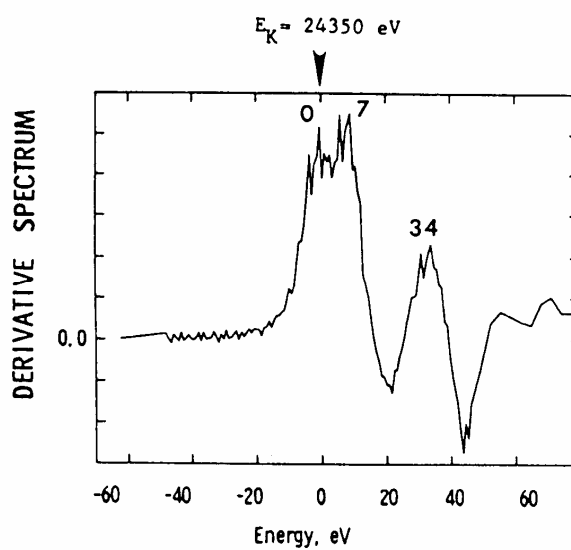
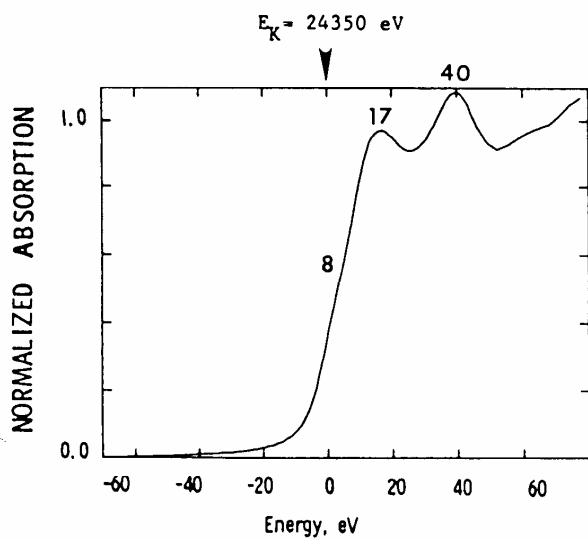
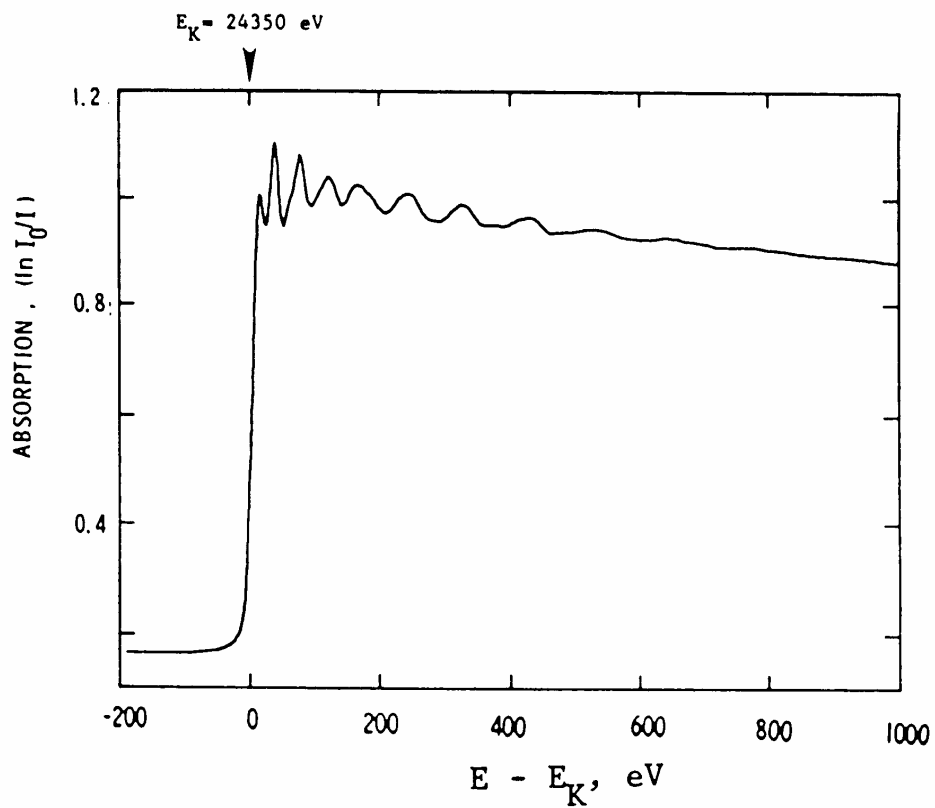


13a

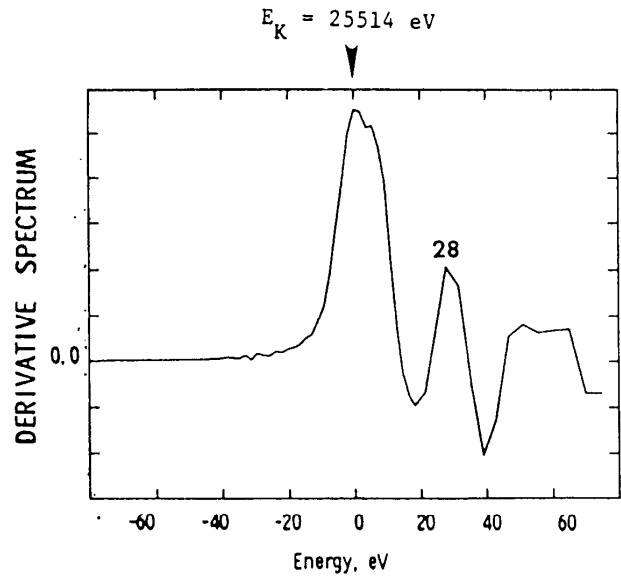
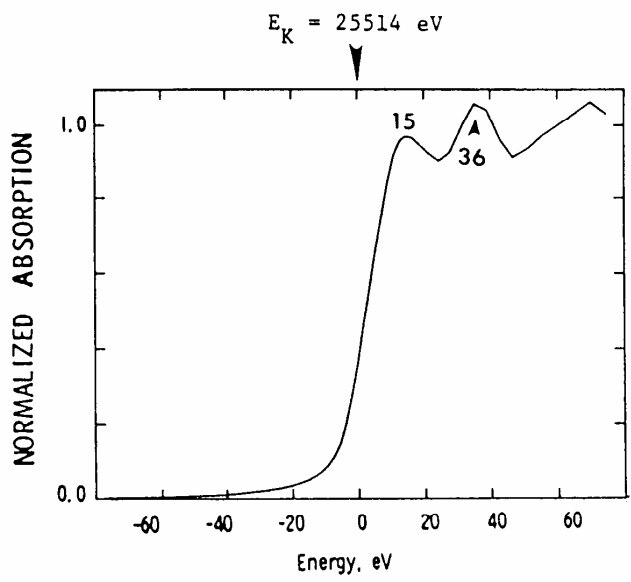
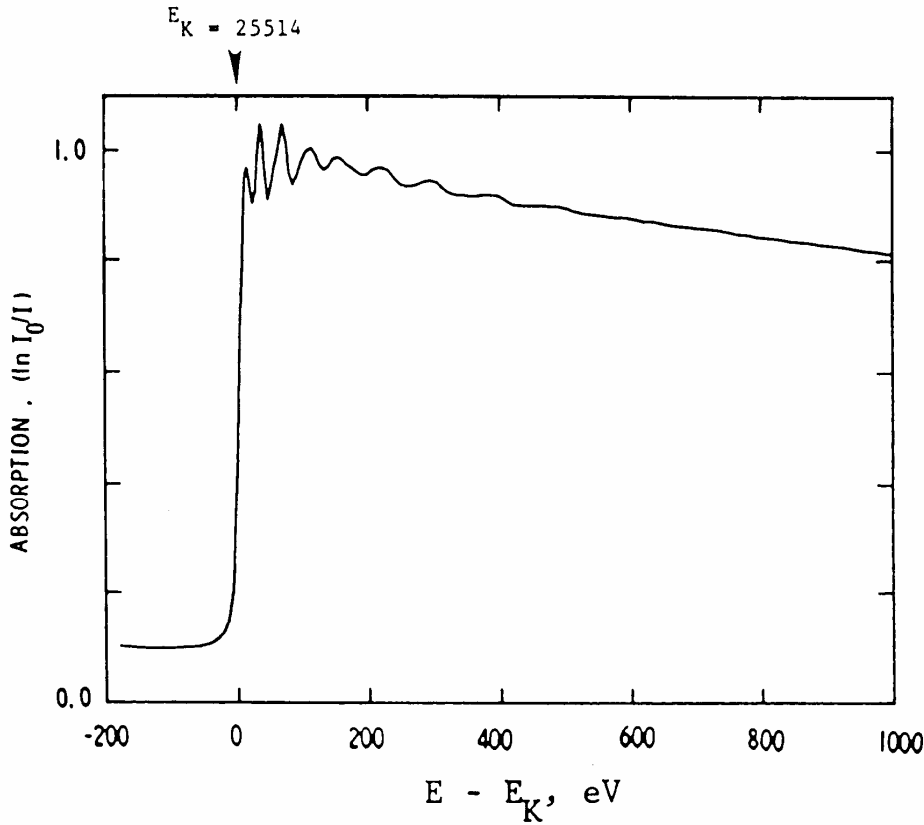
Spectrum at 100K - Courtesy of Farrel Lytle



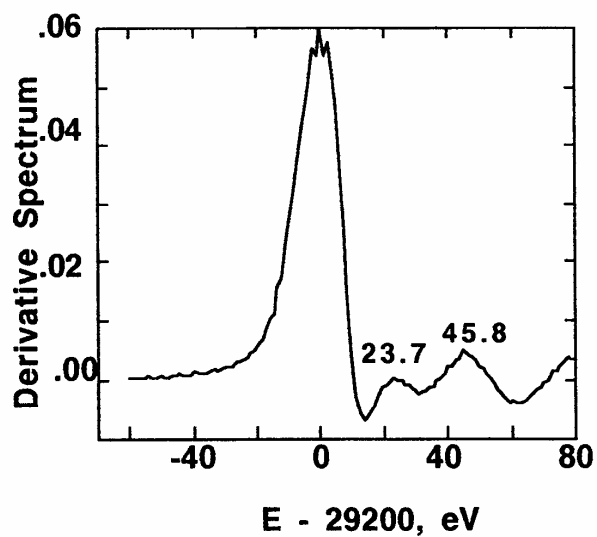
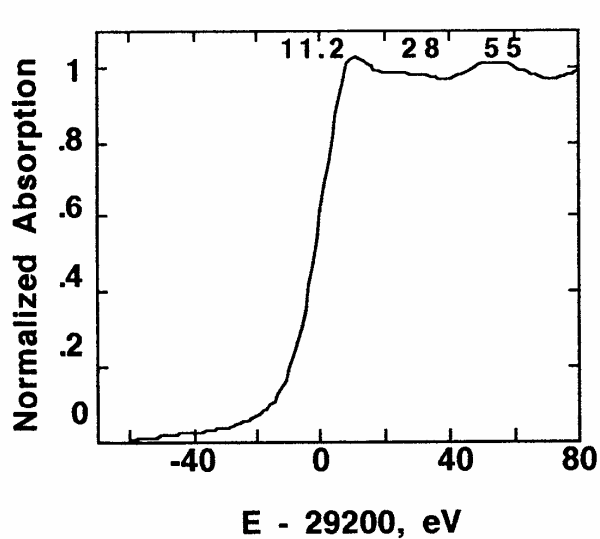
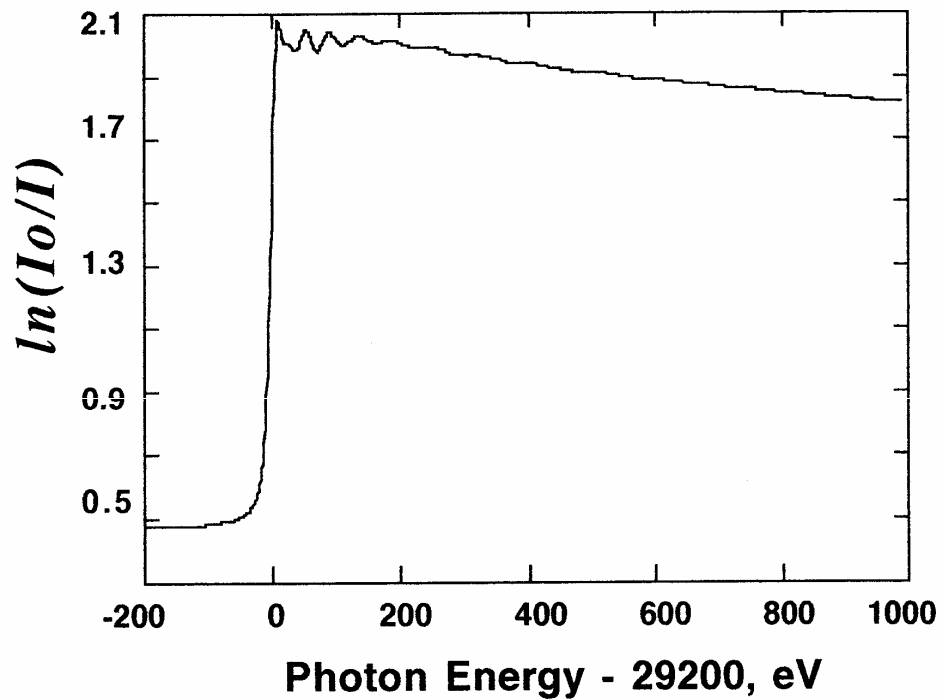
Pd



Ag

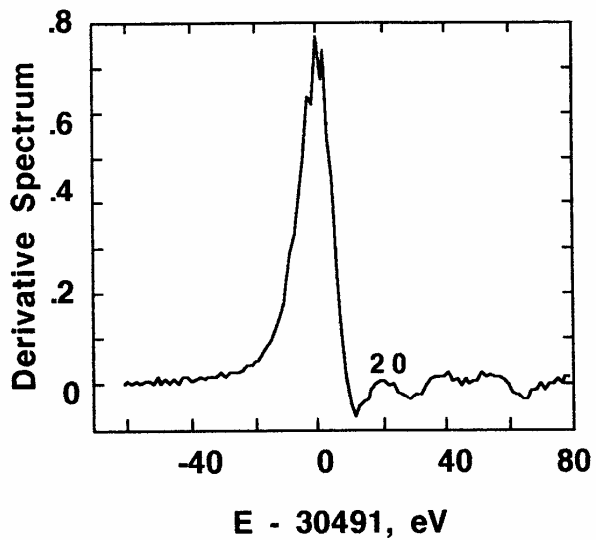
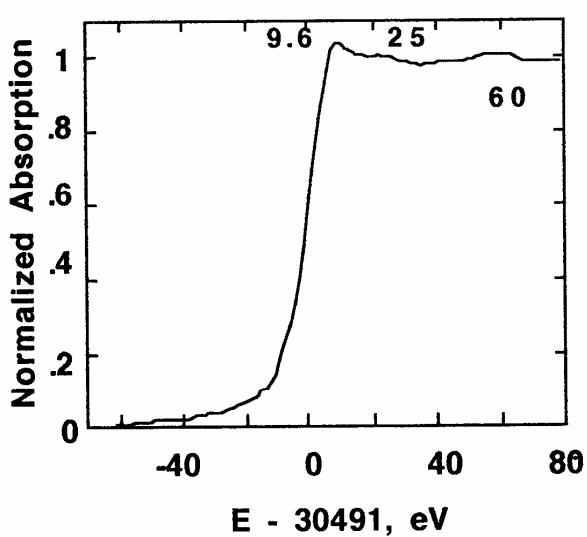
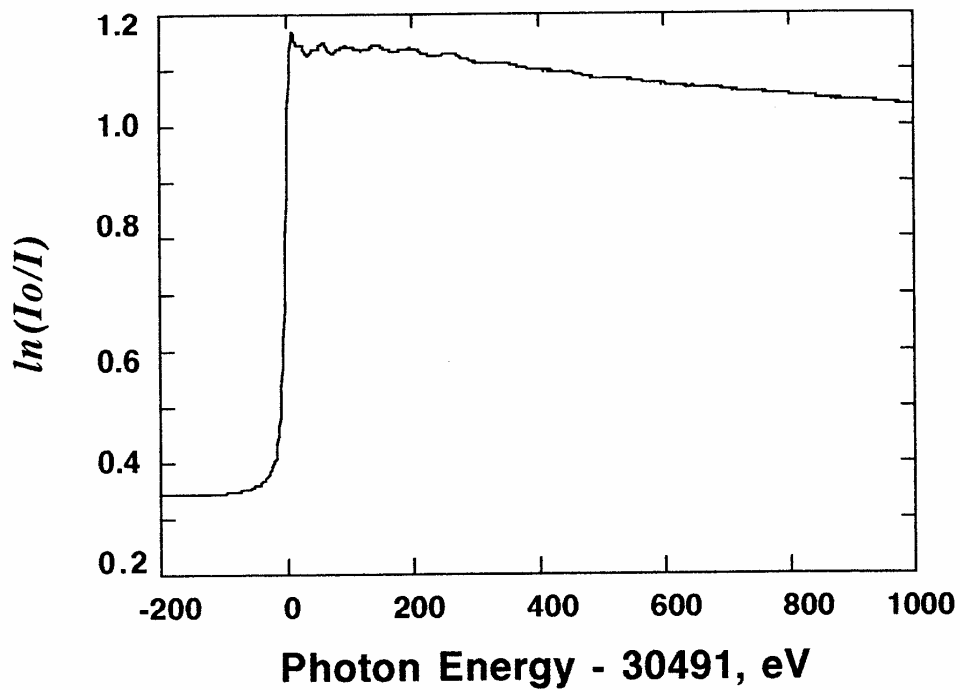


Sn



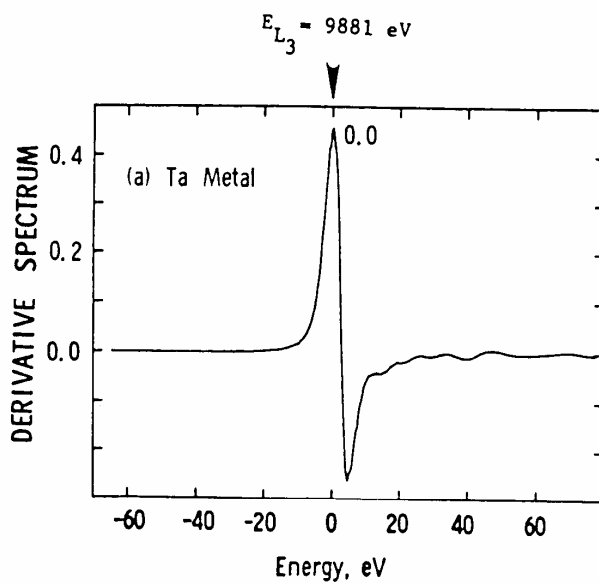
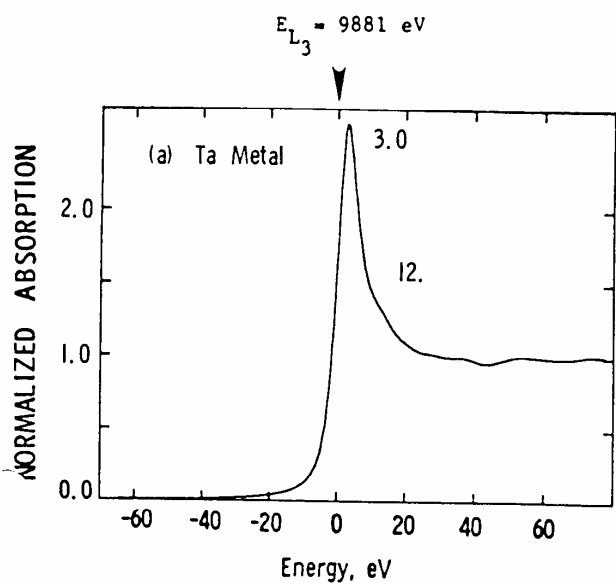
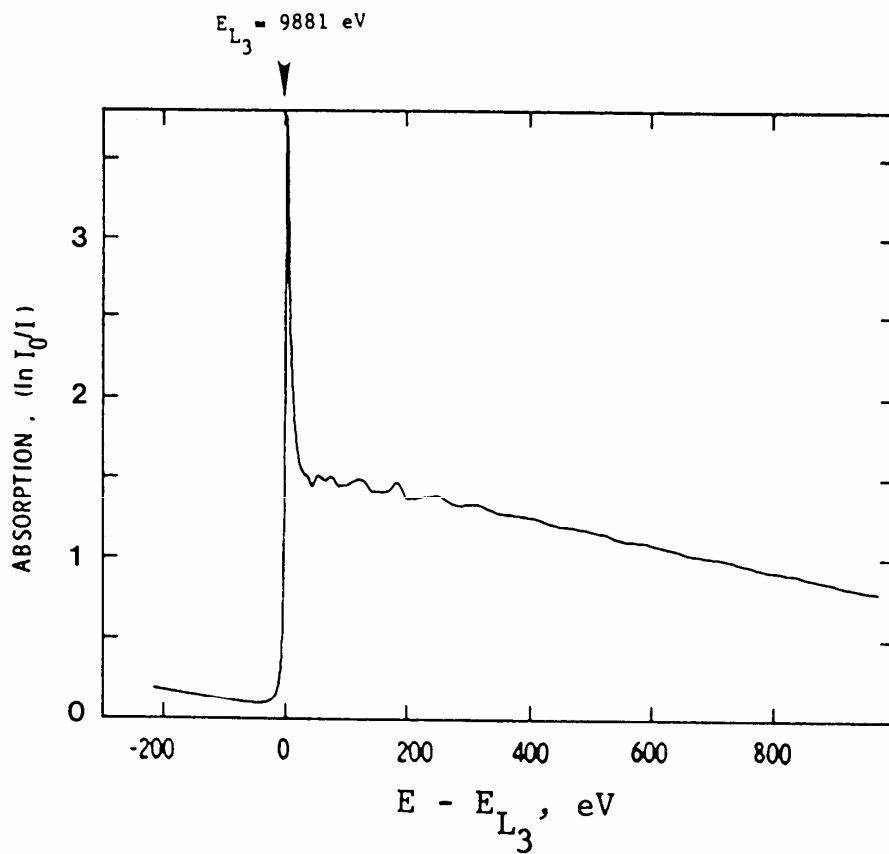
15a

**Sb**

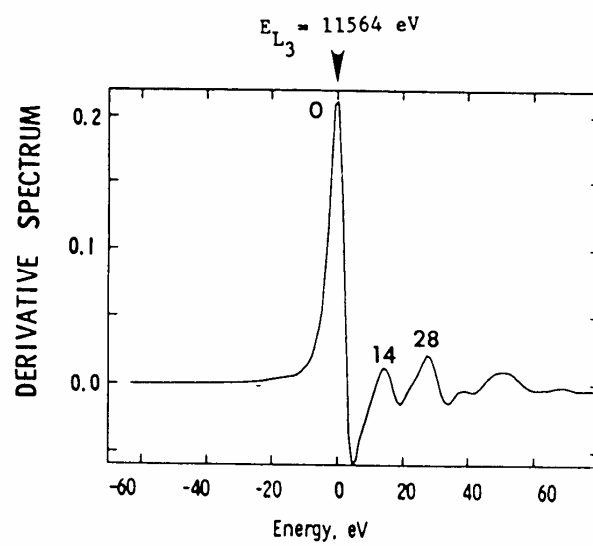
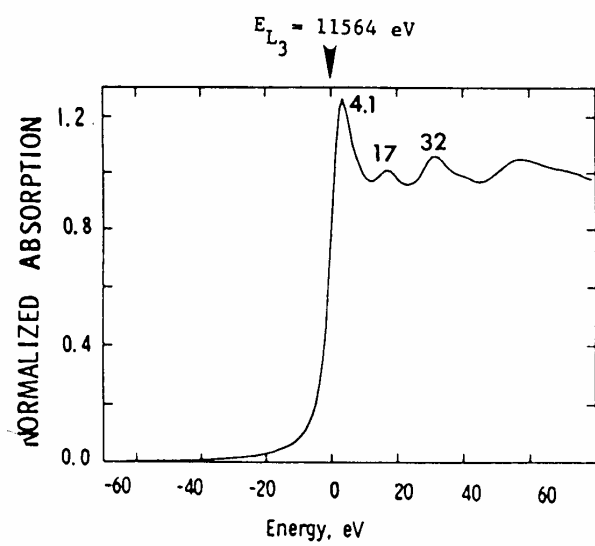
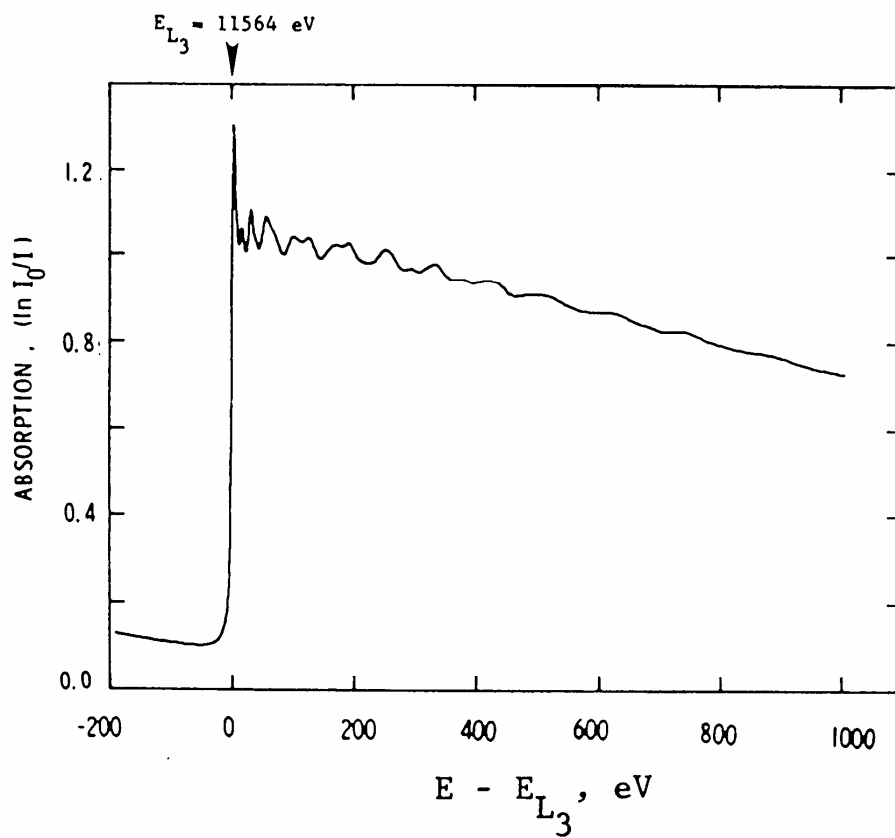


**15b**

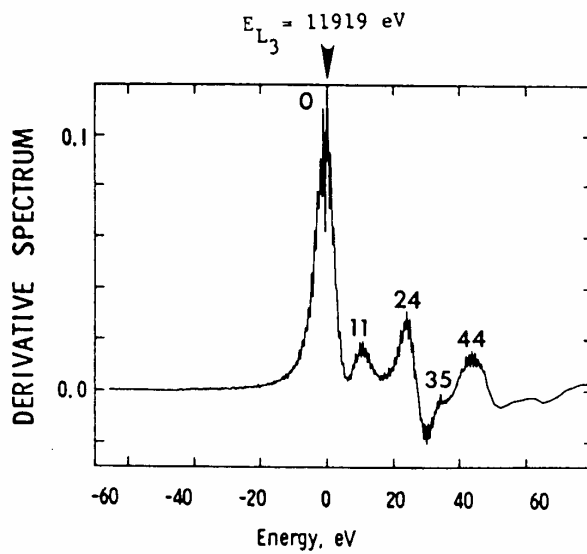
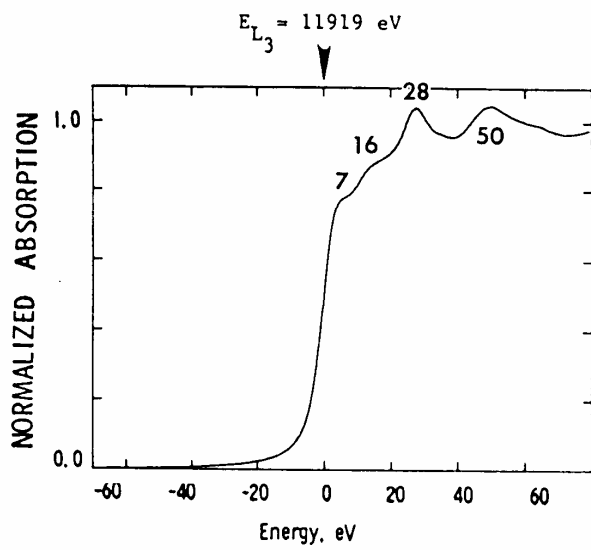
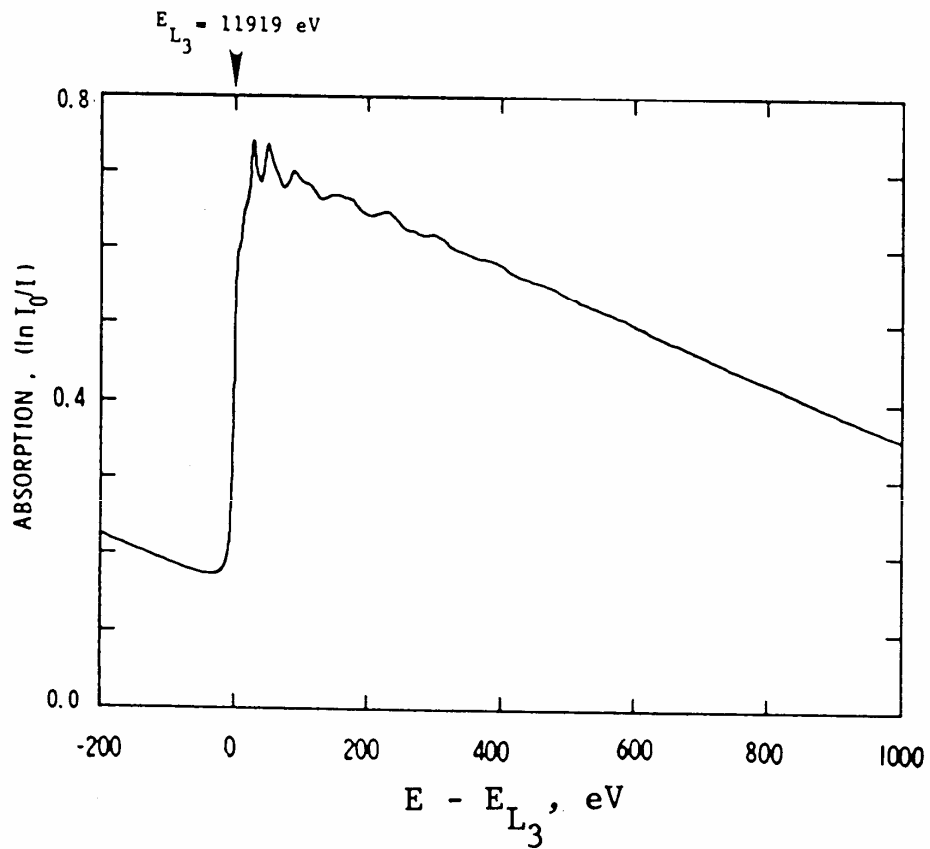
Ta



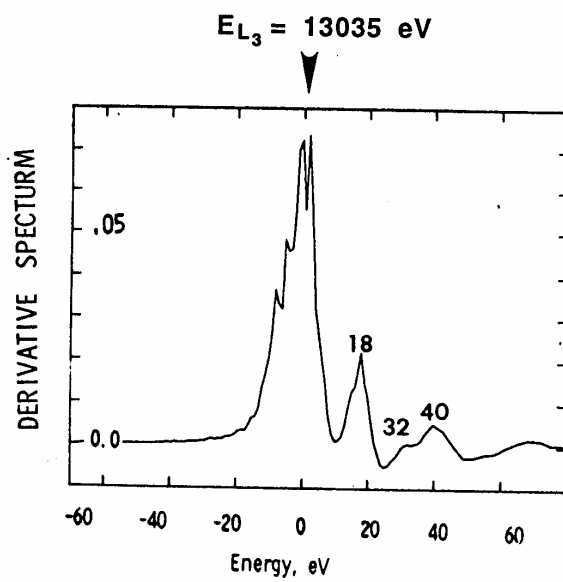
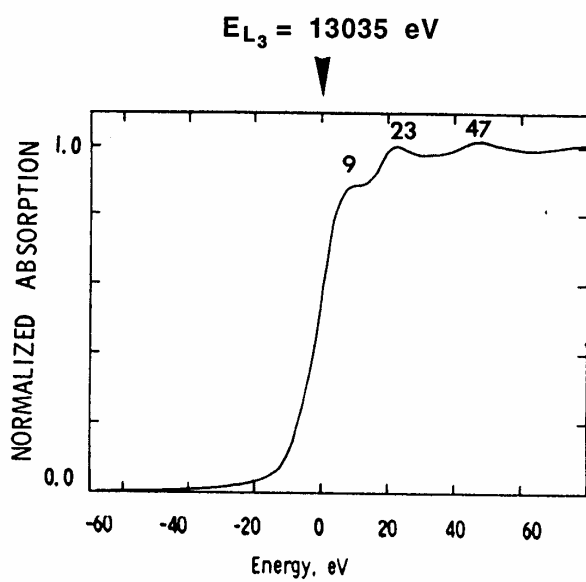
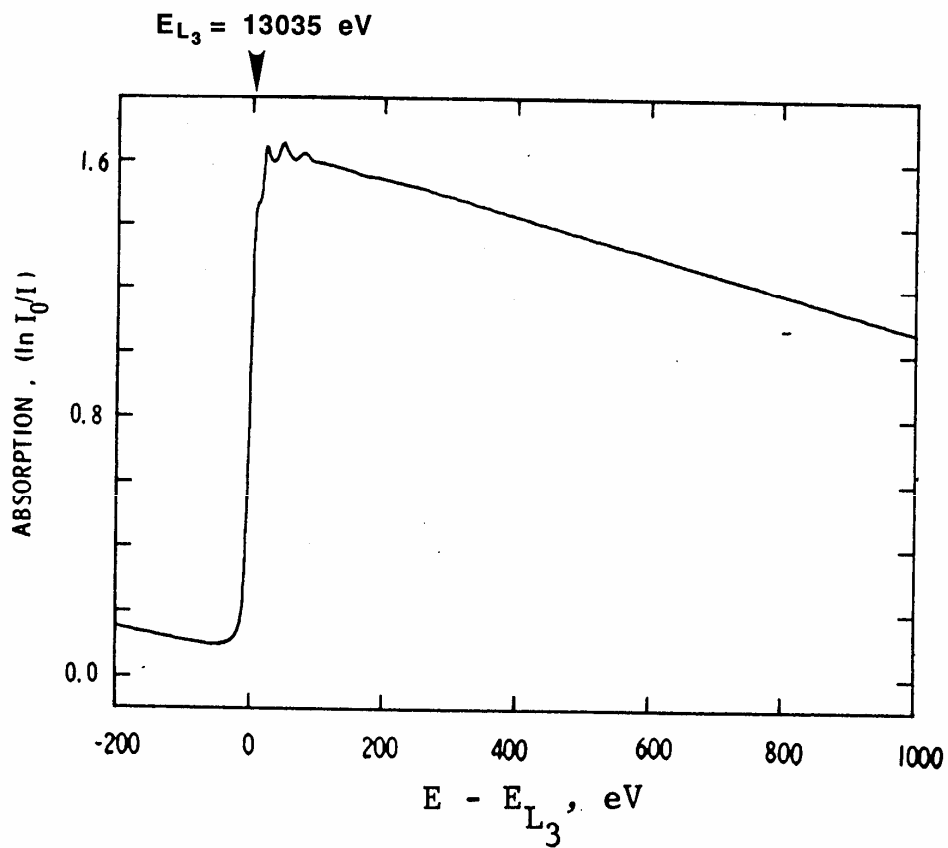
Pt



Au



Pb





## X-ray K- and L-edge Energies of the Elements, eV

Element	Z	K-Edge	L <sub>1</sub>	L <sub>2</sub>	L <sub>3</sub>
H	1	13.6	0.0	0.0	0.0
He	2	24.6	0.0	0.0	0.0
Li	3	54.8	0.0	0.0	0.0
Be	4	111.0	0.0	0.0	0.0
B	5	188.0	0.0	4.7	4.7
C	6	283.8	0.0	6.4	6.4
N	7	401.6	0.0	9.2	9.2
O	8	532.0	23.7	7.1	7.1
F	9	685.4	31.0	8.6	8.6
Ne	10	866.9	45.0	18.3	18.3
Na	11	1072.1	63.3	31.1	31.1
Mg	12	1303.0	89.4	51.4	51.4
Al	13	1559.6	117.7	73.1	73.1
Si	14	1838.9	148.7	99.2	99.2
P	15	2145.5	189.3	132.2	132.2
S	16	2472.0	229.2	164.8	164.8
Cl	17	2822.4	270.2	201.6	200.0
Ar	18	3202.9	320.0	247.3	245.2
K	19	3607.4	377.1	296.3	293.6
Ca	20	4038.1	437.8	350.0	346.4
Sc	21	4492.8	500.4	406.7	402.2
Ti	22	4966.4	563.7	461.5	455.5
V	23	5465.1	628.2	520.5	512.9
Cr	24	5989.2	694.6	583.7	574.5
Mn	25	6539.0	769.0	651.4	640.3
Fe	26	7112.0	846.1	721.1	708.1
Co	27	7708.9	925.6	793.8	778.6
Ni	28	8332.8	1008.1	871.9	854.7
Cu	29	8978.9	1096.1	951.0	931.1
Zn	30	9658.6	1193.6	1042.8	1019.7
Ga	31	10367.1	1297.7	1142.3	1115.4
Ge	32	11103.1	1414.3	1247.8	1216.7
As	33	11866.7	1526.5	1358.6	1323.1
Se	34	12657.8	1653.9	1476.2	1435.8
Br	35	13473.7	1782.0	1596.0	1549.9
Kr	36	14325.6	1921.0	1727.2	1674.9
Rb	37	15199.7	2065.1	1863.9	1804.4
Sr	38	16104.6	2216.3	2006.8	1939.6
Y	39	17038.4	2372.5	2155.5	2080.0
Zr	40	17997.6	2531.6	2306.7	2222.3
Nb	41	18985.6	2697.7	2464.7	2370.5
Mo	42	19999.5	2865.6	2625.1	2520.2
Tc	43	21044.0	3042.5	2793.2	2676.9
Ru	44	22117.2	3224.0	2966.9	2837.9
Rh	45	23219.9	3411.9	3146.1	3003.8
Pd	46	24350.3	3604.3	3330.3	3173.3
Ag	47	25514.0	3805.8	3523.7	3351.0
Cd	48	26711.2	4018.0	3727.0	3537.5
In	49	27939.9	4237.5	3938.0	3730.1
Sn	50	29200.1	4464.7	4156.1	3928.8
Sb	51	30491.2	4698.3	4380.4	4132.2
Te	52	31813.8	4939.2	4612.0	4341.4

## X-ray K- and L-Edge Energies of the Elements, eV

Element	Z	K-Edge	L <sub>1</sub>	L <sub>2</sub>	L <sub>3</sub>
I	53	33169.4	5188.1	4852.1	4557.1
Xe	54	34561.4	5452.8	5103.7	4782.2
Cs	55	35984.6	5714.3	5359.4	5011.9
Ba	56	37440.6	5988.8	5623.6	5247.0
La	57	38924.6	6266.3	5890.6	5482.7
Ce	58	40443.0	6548.8	6164.2	5723.4
Pr	59	41990.6	6834.8	6440.4	5964.3
Nd	60	43568.9	7126.0	6721.5	6207.9
Pm	61	45184.0	7427.9	7012.8	6459.3
Sm	62	46834.2	7736.8	7311.8	6716.2
Eu	63	48519.0	8052.0	7617.1	6976.9
Gd	64	50239.1	8375.6	7930.3	7242.8
Tb	65	51995.7	8708.0	8251.6	7514.0
Dy	66	53788.5	9045.8	8580.6	7790.1
Ho	67	55617.7	9394.2	8917.8	8071.1
Er	68	59389.6	10115.7	9616.9	8648.0
Yb	70	61332.3	10486.4	9978.2	8943.6
Lu	71	63313.8	10870.4	10348.6	9244.1
Hf	72	65350.8	11270.7	10739.4	9560.7
Ta	73	67416.4	11681.5	11136.1	9881.1
W	74	69525.0	12099.8	11544.0	10206.8
Re	75	71676.4	12526.7	11958.7	10535.3
Os	76	73870.8	12968.0	12385.0	10870.9
Ir	77	76111.0	13418.5	12824.1	11215.2
Pt	78	78394.8	13879.9	13272.6	11563.7
Au	79	80724.9	14352.8	13733.6	11918.7
Hg	80	83102.3	14839.3	14208.7	12283.9
Tl	81	85530.4	15346.7	14697.9	12657.5
Pb	82	88004.5	15860.8	15200.0	13035.2
Bi	83	90525.9	16387.6	15711.1	13418.6
Po	84	93105.0	16939.3	16244.3	13813.8
At	85	95729.9	17493.0	16784.7	14213.5
Rn	86	98404.0	18049.0	17337.1	14619.4
Fr	87	101137.0	18639.0	17906.5	15031.2
Ra	88	103921.9	19236.7	18484.3	15444.4
Ac	89	106755.3	19840.0	19083.2	15871.0
Th	90	109650.9	20472.1	19693.2	16300.3
Pa	91	112601.4	21104.6	20313.7	16733.1
U	92	115606.1	21757.4	20947.6	17166.3
Np	93	118678.0	22426.8	21600.5	17610.0
Pu	94	121818.0	23097.2	22266.2	18056.8
Am	95	125027.0	23772.9	22944.0	18504.1
Cm	96	128200.0	24460.0	23779.0	18930.0
Bk	97	131590.0	25275.0	24385.0	19452.0
Cf	98	135960.0	26110.0	25250.0	19930.0
Es	99	139490.0	26900.0	26020.0	20410.0
Fm	100	143090.0	27700.0	26810.0	20900.0
Md	101	146780.0	28530.0	27610.0	21390.0
No	102	150540.0	29380.0	28440.0	21880.0
Lr	103	154380.0	30240.0	29280.0	22360.0

Source: J.A.Bearden and A.F.Burr, Rev.Mod.Phys.39, 125(1967)  
 Tabulated by: B. Rupp and Joe Wong