HETTRICK SCIENTIFIC
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Pioneering state-of-the-art grazing incidence spectrometers for basic physics research since 1987.

CAL-32™
Custom Anode Library

These anode cap sets are designed to be used with the Manson electron impact sources[1], models 2 and 5. As enumerated in the table, the anode library provides a multitude of characteristic lines from K, L and M-shell transitions, as well as Bremsstrahlung continua. The ability to select spectral lines at closely spaced soft x-ray photon energies allows the calibration of spectral features such as filter absorption edges, multilayer (Bragg) interference reflectance peaks and grating efficiency variations (see Fig. 2) without resorting to the use of a synchrotron radiation facility.

The same anode set fits both model 2 and model 5 Manson sources. As specified for each material in the table, the anode caps are constructed of either a) the metal itself, or b) a base of 303 stainless steel with the impact material affixed to the top using low-outgassing silver conductive epoxy. Each anode cap is vented and, following initial break-in, is compatible with vacuum into the 10-8 mbar range. With the exception of Be, all anode caps are reusable indefinitely by nylon pad cleaning of the anode surface after extended use.

Fig. 1 shows the spectrum produced by one typical anode material (zinc), consisting of several useable characteristic L-shell lines, plus an underlying continuum for the atomic number Z=30. As the Bremsstrahlung strength is highly dependent upon Z, the strongest continuum is obtained using tungsten (Z=74). Anode set model CAL-32 comprises the following materials: Be(5), B, C, Sapphire, Mg, Al, Si, Sc, Ti, Cr, Mn, Fe, SS303, Co, Ni, Cu, Zn, Ge, Y, Zr, Nb, Mo, Ru, Rh, Pd, Ag, Sn and W); refer to the characteristic emission line table for the

Characteristic Emission Lines from Electron-Impact Source

Photon Energy eV	Species	Material
49.3	Mg-L/M	Mg (a)
72.4	Al-L/M	Al (a) Sapphire (b)
91.5	Si-L/M	Si (b)
108.5	Be-K	Be (b)
132.8	Y-Mz	Y (b)
151.1	Zr-Mz	Zr (a,b)
171.7	Nb-Mz	Nb (a,b)
183.3	B-K	B (b)
192.6	Mo-Mz	Mo (a,b)
237	Ru-Mz	Ru (b)
eV	**Species**	**Material**
260	Rh-Mz	Rh (b)
277	C-K	Graphite (a)
284.4	Pd-Mz	Pd (b)
311.7	Ag-Mz	Ag (a)
348.3	Sc-Ll	Sc (b)
352.9	Sc-Le	Sc (b)
395.3	Ti-Ll	Ti (a,b)
395.4	Sc-La	Sc (b)

Photon Energy eV	Species	Material
811.1	Cu-Ll	Cu (a)
832	Cu-Le	Cu (a)
851.5	Ni-La	Ni (a)
868.8	Ni-Lb	Ni (a)
884	Zn-Ll	Zn (a)
929.7	Cu-La	Cu (a)
949.8	Cu-Lb	Cu (a)
1011.7	Zn-La	Zn (a)
1034.7	Zn-Lb	Zn (a)
1036.2	Ge-Ll	Ge (b)
eV	**Species**	**Material**
1068	Ge-Le	Ge (b)
1188	Ge-La	Ge (b)
1218.5	Ge-Lb	Ge (b)
1253.6	Mg-Ka	Mg (a)
1302.2	Mg-Kb	Mg (a)
1380	W-Mz	W (b)
1486.7	Al-Ka	Al (a) Sapphire (b)
1557.5	Al-Kb	Al (a) Sapphire (b)

available photon energies.

As an option, enhanced cooling of the operating anodes is available, using forced-air fans combined with a copper-block finned radiator. This is found to improve the positional stability of the emission region of the Manson source and stabilize its output intensity through reduced hydrocarbon contamination.

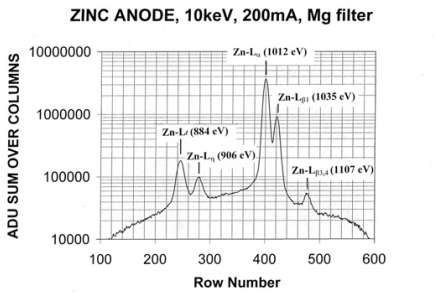

Fig. 1. Spectrum of characteristic lines and Bremsstrahlung continuum from a zinc anode in the Manson model 2 source, using Hettrick SXR-II spectrometer and a CCD detector to record the spectrum.

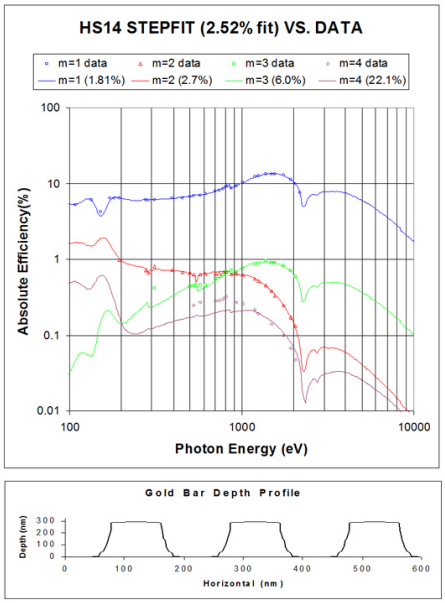

Fig. 2. Absolute efficiency measurements of a free-standing transmission grating, using numerous characteristic lines from CAL-32 anode library and Hettrick SXR-II monochromator.

[1] Manson electron impact sources are manufactured and sold by Austin Instruments, Inc.

website: www.austinst.com
email: austinst@tiac.net
tel: 800-818-7403.

397	Sn-Mz	Sn (a)
399.6	Sc-Lb	Sc (b)
401.3	Ti-Le	Ti (a,b)
eV	**Species**	**Material**
452.2	Ti-La	Ti (a,b)
458.4	Ti-Lb	Ti (a,b)
500.3	Cr-Ll	Cr (b)
510.2	Cr-Le	Cr (b)
524.9	O-K	Sapphire (b)
556.3	Mn-Ll	Mn (b)
567.5	Mn-Le	Mn (b)
572.8	Cr-La	Cr (b)
582.8	Cr-Lb	Cr (b)
615.2	Fe-Ll	Fe/SS303 (a)
628	Fe-Le	Fe/SS303 (a)
eV	**Species**	**Material**
637.4	Mn-La	Mn (b)
648.8	Mn-Lb	Mn (b)
677.8	Co-Ll	Co (b)
694	Co-Le	Co (b)
705	Fe-La	Fe/SS303 (a)
718.5	Fe-Lb	Fe/SS303 (a)
742.7	Ni-Ll	Ni (a)
762	Ni-Le	Ni (a)
776.2	Co-La	Co (b)
791.4	Co-Lb	Co (b)

1685.4	Y-Ll	Y (b)
1740	Si-Ka	Si (b)
eV	**Species**	**Material**
1774	W-Ma	W (b)
1761	Y-Le	Y (b)
1792	Zr-Ll	Zr (a,b)
1835.9	Si-Kb	Si (b)
1876.5	Zr-Le	Zr (a,b)
1902.2	Nb-Ll	Nb (a,b)
1922.6	Y-La	Y (b)
1996.2	Nb-Le	Nb (a,b)
2015.7	Mo-Ll	Mo (a,b)
2042.4	Zr-La	Zr (a,b)
eV	**Species**	**Material**
2165.9	Nb-La	Nb (a,b)
2253	Ru-Ll	Ru (b)
2293.2	Mo-La	Mo (a,b)
2559	Ru-La	Ru (b)
2697	Rh-La	Rh (b)
2839	Pd-La	Pd (b)
2984	Ag-La	Ag (a)
3444	Sn-La	Sn (a)
4091	Sc-Ka	Sc (b)
4511	Ti-Ka	Ti (a,b)
5415	Cr-Ka	Cr (b)