

Research Application

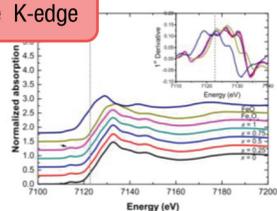
- **Gems, Mineral and Archaeology:**
Determine coloring agents and phases in materials.
- **Biological and Medical Sciences:**
Examine transition metals in soil, water, or plants.
- **Catalysts:** Study of oxidation states, coordination numbers, bond lengths, neighboring atoms, and chemical structures of central atoms.
- **Ceramics and Polymer:** Study the impurities in polymeric structure, improve product quality, and develop new products.



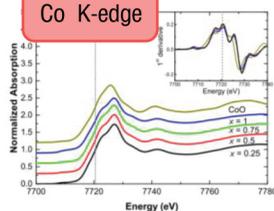
Research Highlights

- Study the effect of the Mg addition on the cation distribution of CoFe_2O_4 nanoparticles

Fe K-edge

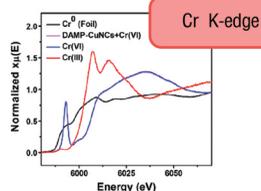


Co K-edge



P. Chirawatkul, J. Alloy. Compd., 697 (2017) 249-256

- Detection of oxidation state of Cr ions after the addition of a trace level of CrO_4^{2-} into low concentration DAMP-CuNCs



Khonkayan, K. et al. Microchim Acta, 184 (2017) 2965-2974.

Measurable Elements at BL1.1W

Key:		atomic number		Symbol		name		conventional atomic weight		standard atomic weight	
		K-edge		L3-edge							
1	H	1	Li	3	Li	6.941	6.941	13	Al	13	Al
2	He	4	Be	4	Be	9.0122	9.0122	14	Si	14	Si
3	Li	5	B	5	B	10.811	10.811	15	P	15	P
4	Be	6	C	6	C	12.011	12.011	16	S	16	S
5	B	7	N	7	N	14.007	14.007	17	Cl	17	Cl
6	C	8	O	8	O	15.999	15.999	18	Ar	18	Ar
7	N	9	F	9	F	18.998	18.998	19	K	19	K
8	O	10	Ne	10	Ne	20.180	20.180	20	Ca	20	Ca
9	F	11	Na	11	Na	22.990	22.990	21	Sc	21	Sc
10	Ne	12	Mg	12	Mg	24.305	24.305	22	Ti	22	Ti
11	Na	13	Al	13	Al	26.982	26.982	23	V	23	V
12	Mg	14	Si	14	Si	28.086	28.086	24	Cr	24	Cr
13	Al	15	P	15	P	30.974	30.974	25	Mn	25	Mn
14	Si	16	S	16	S	32.06	32.06	26	Fe	26	Fe
15	P	17	Cl	17	Cl	35.45	35.45	27	Co	27	Co
16	S	18	Ar	18	Ar	39.95	39.95	28	Ni	28	Ni
17	Cl	19	K	19	K	39.098	39.098	29	Cu	29	Cu
18	Ar	20	Ca	20	Ca	40.078	40.078	30	Zn	30	Zn
19	K	21	Sc	21	Sc	44.956	44.956	31	Ga	31	Ga
20	Ca	22	Ti	22	Ti	47.88	47.88	32	Ge	32	Ge
21	Sc	23	V	23	V	50.942	50.942	33	As	33	As
22	Ti	24	Cr	24	Cr	52.004	52.004	34	Se	34	Se
23	V	25	Mn	25	Mn	54.938	54.938	35	Br	35	Br
24	Cr	26	Fe	26	Fe	55.845	55.845	36	Kr	36	Kr
25	Mn	27	Co	27	Co	58.933	58.933	37	Rb	37	Rb
26	Fe	28	Ni	28	Ni	58.693	58.693	38	Sr	38	Sr
27	Co	29	Cu	29	Cu	63.546	63.546	39	Y	39	Y
28	Ni	30	Zn	30	Zn	65.38	65.38	40	Zr	40	Zr
29	Cu	31	Ga	31	Ga	69.723	69.723	41	Nb	41	Nb
30	Zn	32	Ge	32	Ge	72.630	72.630	42	Mo	42	Mo
31	Ga	33	As	33	As	74.922	74.922	43	Tc	43	Tc
32	Ge	34	Se	34	Se	78.96	78.96	44	Ru	44	Ru
33	As	35	Br	35	Br	79.904	79.904	45	Rh	45	Rh
34	Se	36	Kr	36	Kr	83.80	83.80	46	Pd	46	Pd
35	Br	37	Rb	37	Rb	85.468	85.468	47	Ag	47	Ag
36	Kr	38	Sr	38	Sr	87.62	87.62	48	Cd	48	Cd
37	Rb	39	Y	39	Y	88.906	88.906	49	In	49	In
38	Sr	40	Zr	40	Zr	91.224	91.224	50	Sn	50	Sn
39	Y	41	Nb	41	Nb	92.906	92.906	51	Sb	51	Sb
40	Zr	42	Mo	42	Mo	95.94	95.94	52	Te	52	Te
41	Nb	43	Tc	43	Tc	98.906	98.906	53	I	53	I
42	Mo	44	Ru	44	Ru	101.07	101.07	54	Xe	54	Xe
43	Tc	45	Rh	45	Rh	102.91	102.91	55	Cs	55	Cs
44	Ru	46	Pd	46	Pd	106.42	106.42	56	Ba	56	Ba
45	Rh	47	Ag	47	Ag	107.87	107.87	57	La	57	La
46	Pd	48	Cd	48	Cd	112.41	112.41	58	Ce	58	Ce
47	Ag	49	In	49	In	114.82	114.82	59	Pr	59	Pr
48	Cd	50	Sn	50	Sn	118.71	118.71	60	Nd	60	Nd
49	In	51	Sb	51	Sb	121.76	121.76	61	Pm	61	Pm
50	Sn	52	Te	52	Te	127.60	127.60	62	Sm	62	Sm
51	Sb	53	I	53	I	126.905	126.905	63	Eu	63	Eu
52	Te	54	Xe	54	Xe	131.29	131.29	64	Gd	64	Gd
53	I	55	Cs	55	Cs	132.91	132.91	65	Tb	65	Tb
54	Xe	56	Ba	56	Ba	137.33	137.33	66	Dy	66	Dy
55	Cs	57	La	57	La	138.91	138.91	67	Ho	67	Ho
56	Ba	58	Ce	58	Ce	140.12	140.12	68	Er	68	Er
57	La	59	Pr	59	Pr	140.91	140.91	69	Tm	69	Tm
58	Ce	60	Nd	60	Nd	144.24	144.24	70	Yb	70	Yb
59	Pr	61	Pm	61	Pm	144.91	144.91	71	Lu	71	Lu
60	Nd	62	Sm	62	Sm	150.36	150.36	72	Hf	72	Hf
61	Pm	63	Eu	63	Eu	151.96	151.96	73	Ta	73	Ta
62	Sm	64	Gd	64	Gd	157.25	157.25	74	W	74	W
63	Eu	65	Tb	65	Tb	158.93	158.93	75	Re	75	Re
64	Gd	66	Dy	66	Dy	162.50	162.50	76	Os	76	Os
65	Tb	67	Ho	67	Ho	164.93	164.93	77	Ir	77	Ir
66	Dy	68	Er	68	Er	167.26	167.26	78	Pt	78	Pt
67	Ho	69	Tm	69	Tm	168.93	168.93	79	Au	79	Au
68	Er	70	Yb	70	Yb	173.05	173.05	80	Hg	80	Hg
69	Tm	71	Lu	71	Lu	174.97	174.97	81	Tl	81	Tl
70	Yb	72	Hf	72	Hf	178.49	178.49	82	Pb	82	Pb
71	Lu	73	Ta	73	Ta	180.95	180.95	83	Bi	83	Bi
72	Hf	74	W	74	W	183.85	183.85	84	Po	84	Po
73	Ta	75	Re	75	Re	186.21	186.21	85	At	85	At
74	W	76	Os	76	Os	190.23	190.23	86	Rn	86	Rn
75	Re	77	Ir	77	Ir	192.22	192.22	87	Fr	87	Fr
76	Os	78	Pt	78	Pt	195.08	195.08	88	Ra	88	Ra
77	Ir	79	Au	79	Au	196.97	196.97	89	Ac	89	Ac
78	Pt	80	Hg	80	Hg	200.59	200.59	90	Th	90	Th
79	Au	81	Tl	81	Tl	204.38	204.38	91	Pa	91	Pa
80	Hg	82	Pb	82	Pb	207.2	207.2	92	U	92	U
81	Tl	83	Bi	83	Bi	208.98	208.98	93	Np	93	Np
82	Pb	84	Po	84	Po	209	209	94	Pu	94	Pu
83	Bi	85	At	85	At	210	210	95	Am	95	Am
84	Po	86	Rn	86	Rn	222	222	96	Cm	96	Cm
85	At	87	Fr	87	Fr	223	223	97	Bk	97	Bk
86	Rn	88	Ra	88	Ra	226	226	98	Cf	98	Cf
87	Fr	89	Ac	89	Ac	227	227	99	Es	99	Es
88	Ra	90	Th	90	Th	232.04	232.04	100	Fm	100	Fm
89	Ac	91	Pa	91	Pa	231.04	231.04	101	Md	101	Md
90	Th	92	U	92	U	238.03	238.03	102	No	102	No
91	Pa	93	Np	93	Np	237.05	237.05	103	Lr	103	Lr
92	U	94	Pu	94	Pu	244.06	244.06	104		104	
93	Np	95	Am	95	Am	243.06	243.06	105		105	
94	Pu	96	Cm	96	Cm	247.07	247.07	106		106	
95	Am	97	Bk	97	Bk	247.07	247.07	107		107	
96	Cm	98	Cf	98	Cf	251.08	251.08	108		108	
97	Bk	99	Es	99	Es	252.08	252.08	109		109	
98	Cf	100	Fm	100	Fm	257.10	257.10	110		110	
99	Es	101	Md	101	Md	258.10	258.10	111		111	
100	Fm	102	No	102	No	259.10	259.10	112		112	
101	Md	103	Lr	103	Lr	260.10	260.10	113		113	
102	No	104		104		261.10	261.10	114		114	
103	Lr	105		105		262.10	262.10	115		115	
104		106		106		263.10	263.10	116		116	
105		107		107		264.10	264.10	117		117	
106		108		108		265.10	265.10	118		118	
107		109		109		266.10	266.10	119		119	
108		110		110		267.10	267.10	120		120	
109		111		111		268.10	268.10	121		121	
110		112		112		269.10	269.10	122		122	
111		113		113		270.10	270.10	123		123	
112		114		114		271.10	271.10	124		124	
113		115		115		272.10	272.10	125		125	
114		116		116		273.10	273.10	126		126	
115		117		117		274.10	274.10	127		127	
116		118		118		275.10	275.10	128		128	
117		119		119		276.10	276.10	129		129	
118		120		120		277.10	277.10	130		130	
119		121		121		278.10	278.10	131		131	
120		122		122		279.10	279.10	132		132	
121		123		123		280.10	280.10	133		133	
122		124		124		281.10	281.10	134		134	
123		125		125		282.10	282.10	135			

Technical Specifications

► Radiation Source:

Multipole Wiggler

► Photon Energy Range:

4-18 keV

► Photon Flux:

10^7 - 10^{10} phs/sec/0.1%bw (at 100 mA)

► Energy Resolution:

10^{-4}

► X-ray Beam Size:

6 mm (H) x 3 mm (V)

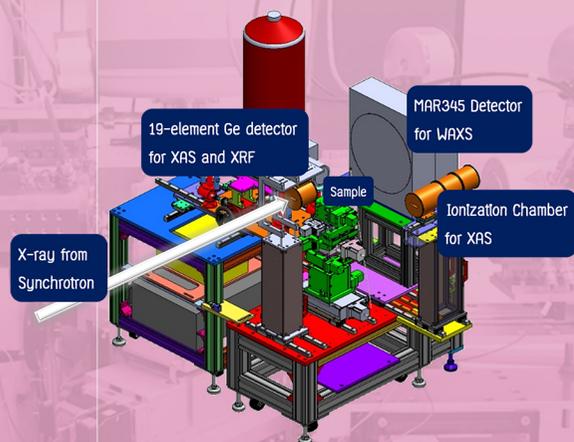
► X-ray Techniques:

- X-ray Absorption Spectroscopy (XAS)
- X-ray Fluorescence (XRF)
- Wide Angle X-ray Scattering (WAXS)
- X-ray Powder Diffraction (XRD) (end of 2018)

► Detectors:

- Transmission XAS: Ionization Chamber
- Fluorescence XAS and XRF: 19-element Ge detector
- WAXS: Image Plate detector (MAR345)

End-Station Layout

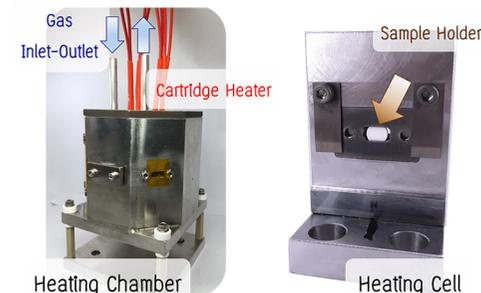


Brief Information

BL1.1W is operated on a 2.4 T Multipole Wiggler (MPW). The X-ray beam is optimized by a vertical collimating mirror (CM) and a toroidal focusing mirror (FM). The x-ray energy is scanned by using a fixed-exit double crystal monochromator (DCM) equipped with a pair of Si (111) crystals. The end-station is dedicated to various X-ray techniques including X-ray Absorption Spectroscopy (XAS), X-ray Fluorescence (XRF), Wide Angle X-ray Scattering (WAXS), and X-ray Diffraction (XRD). All experimental techniques can be requested within the same proposal.

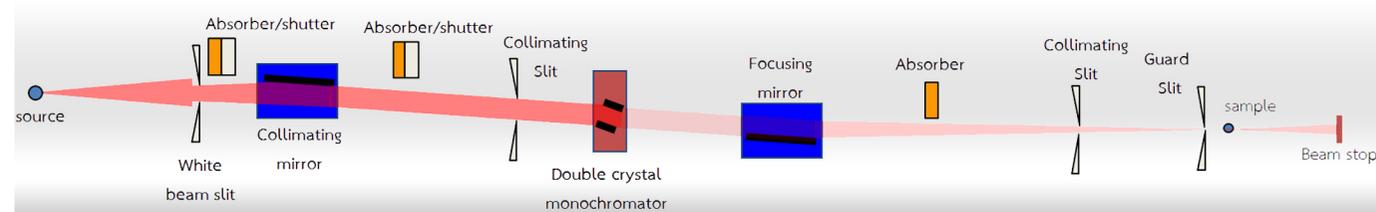
BL1.1W has been operational since November 2016, and since January 2017, under collaboration with Khon Kaen University (KKU). The beamtime at BL1.1W is divided equally between SLRI users and lecturers or researchers from the KKU. All users can submit their beamtime proposal via the SLRI website.

A heating cell is available for in-situ experiments to study the change of oxidation states or local structures as a function of temperature. The temperature program can be controlled in 3 modes, (1) continuous heating, (2) step-wise heating, and (3) step-wise heating-cooling cycles, in the range of 30-750°C. During the process, oxidizing (O_2 , air) or inert (He, Ar, and N_2) gases can be fed into the heating chamber.



XRF

XRF is a non-destructive experimental technique for elemental analysis. A detection limit down to 50 ppm could be achieved. The analysis can be done qualitatively or quantitatively.



Beamline Layout (side view)

XAS

XAS is employed to study chemical and local structures of absorbing atoms. It is a non-destructive chemical analysis which can be carried out on various materials despite their low concentration (> 100 ppm). Samples can be measured in transmission or fluorescence modes or both simultaneously.

WAXS

The crystallinity and crystal structure of materials can be investigated by the WAXS technique. The technique is based on an analysis of Bragg peaks scattered by the samples at wide angles. At BL1.1W, the angular coverage is 5-70