

Notebook - Grating Eff. Measurements Nov 30 - Dec 2

Machine

- 2mm pinhole - typical for grating measurements
- sample - xyz, tilt, theta
- detectors:
 - Hamamatsu photodiode (Gallium arsenide) [used for all measurements that we did]
 - IRD silicon photodiode
 - CCD behind phosphor plate
 - channeltron
- mounted on theta spinning around chamber
- Polarization: 90%*s*, 10%*p*

z-Alignment procedure

- crude - move sample to 0degrees, move up until just starts to block light (watch with CCD camera)
- Accurate: set sample at 2 degrees (from grazing) and detector(CCD) at 4 degrees and look at 0-order light. move down until find grating edge (no more reflected light); move up until you find grating edge (no more reflected light); go to halfway position.

energy Calibration procedure

- move grating out of way
- Scan a reference sample edge using photodiode
- shift by distance between theoretical and measured edges (halfway-height)

absorbers:

- 300nm to 1 μ m (designed take out 50% or more of the light)

- use to filter out everything above filter absorption edge (ie: measurement range at energies just below filter absorption edge) This takes out higher-order (higher-energy) light.

normalizing:

$$(R - \text{Dark})/R_{\text{ringCurrent}}$$

$$N = \text{-----}$$

$$(I_0 - \text{Dark})/I_{\text{ringCurrent}}$$

Scan procedure:

- align sample (theta, z)

- scan theta at same time as wavelength, staying on calculated diffraction peak (Need to know line density very well for this to work)

Scan set 1:

Range: nm (eV)	Filter	Comments	File
11 - 15 (15 steps) (~ 82.6 - 112)	Be (C at 10 degrees)		
		energy calibration files (scan Si edge and see how far off)	
		I0 (sample removed) - direct beam	6
		dark current - gain 8	7
		detector scan (grating in beam) - angle check	8
		First order LEG wavelength scan	9

Range: nm (eV)	Filter	Comments	File
		2nd order LEG wavelength scan normalize using "normalize-sei" (uses measured, I0, dark currents)	10
		dark current scan with grating in	11
8.4 - 11.6(50 steps) (103 - 155)	Boron (C at 8 deg)	direct beam	12
		detector scan (nailed the peak locations)	13
		First order LEG wavelength scan	14
		2nd order LEG wavelength scan (ABORTED)	15
		2nd order LEG wavelength scan	16
		Notes on normalized data: small offset due to angle error	
6.6 - 8.8 (50 steps) (141 - 188)	still boron (C at 6.2 deg)	Grating change: energy re-calibration and realign z (due to beam shifting)	
		calibration error (need to add 0.0081nm at boron edge:)	17
		direct beam -	18
7.7nm		detector scan (check): order locations good!	19
		LEG first order	21
		LEG second order	22
Tip angle realignment (need to finish by theta angle adjustment) SHOULD FIX PROBLEM WITH JUMPS IN 2nd ORDER			

Range: nm (eV)	Filter	Comments	File
		repeat of second order scan	23
IF TIME LEFT: need to repeat LEG 2nd Order from 103 - 155 (B) / scan 16			
6.8 - 4.5 (100 steps)	Carbon (Ni @ 6.2 deg)	adjusting order supressor: Nickel at 8 deg. direct beam	24
5.19nm		detector scan	25
		LEG first order - JUNKED	26
		Leg 2nd order - JUNKED (backwards)	27
		LEG first order	29
		LEG 2nd order	30
		direct beam for 30	31
Switching to impurity grating			
4.5 - 6.8 (100steps) (260-454)	C (Ni @ 8 deg)	direct beam	32
5.19		detector scan (align good)	35
		1st order scan - ALIGNMENT PROBLEM	36
		2nd order scan - ALIGNMENT PROBLEM	37
2.73 - 4.77 (200)	Ni @6.2 deg)	direct beam	42
		detector	43
		1st order (mess due to carbon edge contamination on mirrors)	44
		2nd order (ditto for mess)	45
48, 49, 50: repeat of 32, 36, 37 (ALIGNMENT PROBLEM FIXED - good lineup)			

Range: nm (eV)	Filter	Comments	File
6.6 - 8.8 (50steps)	B (C @ 6.2 deg)	direct beam: BAD - missing filter	51
		1st order	52
		repeat direct beam - GOOD NOW	53
Grating switch - 1200l/mm			
2.27 - 2.81 (150)	Cr (no order sup.)	direct beam	54
		energy calibration test: offset is 0.0026nm (2.2 should be 2.2026) (Sample is Cr)	55
2.702nm		spot check: good!	
		1st order	56
		2nd order	57
1.6 - 2.21 (200)	Co (no order sup.)	direct beam	58
		1st order	59
		2nd order	60
2.2 - 2.28 (10steps)	Co (no order sup.)	direct beam	61
		1st order	62
		2nd order	63
1.33 - 1.65 (200)	Cu (no order sup.)	direct beam	65
		1st order - JUNK backwards	66
		2nd order - JUNK didn't finish	--
GRATING SWITCH (200l/mm)			
8.4 - 11.6 (50steps) (107 - 147)	B (Carbon at 8 deg)	Calibration: need to add +0.0011nm	67
		Direct beam	68
		IMP 1st order	69

Range: nm (eV)	Filter	Comments	File
11.1 -13.9(20steps)	Be (Carbon 8 deg)	Direct beam	70
		IMP 1st order	71
		redo (problem with script - zeroes)	72
SAMPLE SWITCH: Grat. 5 and 6	Cr (no order sup)	cr edge scan (need to add 0.0025 to get actual wavelength)	74
2.27 - 2.81 (150) (440 - 574)	grating 5 (sample 2 degrees incidence)	direct beam	75
		Grat5 (XMEG) 1st order	76
		Grat5 (XMEG) 3rd order	77
1.6 - 2.28 (200) (560 - 776)	Co (no order sup)	direct beam	78
		1st order	79
		3rd order	80
1.33 - 1.65 (150) (752 - 932)	Cu (no order sup.)	direct beam	82
		1st order	83
		3rd order	84
Grating switch -- GRATING 6 (XHEG)			
2.27 - 2.81 (150) (440 - 574)	Cr (no order sup.)	detector scan - GR 6!!! Looks good - 3rd order peak correct using assumed 2600l/mm	85
		direct beam	86
		1st order	87
		3rd order	88
1.6 - 2.28 (200) (560 - 776)	Co (no order sup)	direct beam	89

Range: nm (eV)	Filter	Comments	File
		1st order	90
		3rd order	91
1.33 - 1.65 (150) (752 - 932)	Cu (no order sup.)	direct beam	92
		1st order	93
		3rd order	94
0.95 - 1.38 (200)	Mg (no order sup.)	direct beam	95
		1st order	96
		3rd order	97
Switch mono gratings: grating 600; Ti with Nickel @ 6.2 order sup.			
2.72 - 2.76 (40)	Ti (nickel @ 6.2)	calibration scan (need to add -0.0050)	--
2.73 - 4.44 (200) (260 - 454)		direct beam - BAD (replace with 106)	99
			100
			101
Switch to G5 - same energy range		G5 1st - MISALIGEND	102
		G5 3rd - MISALIGNED	103
		G5 1st order - GOOD	104
		G5 3rd order - GOOD	105
		Direct beam for 104,105 and 100,101	106
End of Friday!!!!			
Sunday, Dec. 2, 2007: Filed mounting plate to fit Grating 4 (HEG)... ultrasound cleaned and mounted MEG and HEG in diffractometer			

Range: nm (eV)	Filter	Comments	File
2.15 - 2.20nm (50)		Cromium edge energy calibration (107 on wrong diode)	107
		silicon photodiode cal. cal: -0.0002nm	108
		gallium arsenide cal. cal: -0.0007nm	110
2.27 - 2.81 (150) (440 - 574)	Cr (no order sup.)	direct beam	111
		detector scan	112
		HEG 1st order	113
		HEG 2nd order	115
		dark current scan (gain 10)	116
1.6 - 2.28 (250) (560 - 776)ev	Co (no order sup.)	direct beam	118
		HEG 1st order (spike is filter edge)	119
		HEG 2nd order	120
1.33 - 1.65 (150) (752-932)ev	Cu (no order sup.)	direct beam	121
		HEG 1st order	122
		HEG 2nd order	123
0.95 - 1.38 (300) (900 - 1300)ev	Mg (no order sup.)	direct beam	124
		HEG 1st order THIS GRATING SUCKS - BIGTIME! supposed to be 12% efficient (actually less than 1% all over)	125

Range: nm (eV)	Filter	Comments	File
		HEG 2nd order (gain 10, like all m=2)	126
Switch to grating 3 - MEG			
2.27 - 2.81 (150) (440 - 574)ev	Cr (no order sup.)	direct beam	127
		MEG 1st order	128
		MEG 2nd order	129
1.6 - 2.28 (250) (560 - 776)ev	Co (no order sup.)	direct beam	130
		HEG 1st order	131
		HEG 2nd order	132
1.33 - 1.65 (150) (752-932)ev	Cu (no order sup.)	direct beam	133
		HEG 1st order	134
		HEG 2nd order	135
Mono Grating switch: 600l/mm, change order suppressor and recal. energy			
Sample realignment (due to beam shift)			
2.72 - 2.76 (40)	Ti (nickel @ 6)	calibration scans (silicon photodiode, not GaAs pd) (need to add +0.0021)nm	136-140
2.73 - 4.77 (250) (260 - 454)		direct beam	141
		MEG 1st order	142
		MEG 2nd order	143
4.5 - 6.8 (100) 181 - 283	C (nickel @ 8)	direct beam	144
		MEG 1st order	145

Range: nm (eV)	Filter	Comments	File
		MEG 2nd order	146
sample switch to HEG			
2.73 - 4.77 (250) (260 - 454)	Ti (Ni @ 6.2)	direct beam	147
		HEG 1st order (2nd order skipped)	148
sample switch back to MEG; due to absorber change: sample realign			
6.6 - 8.8 (50) (141 - 187)	B (C at 6.2)	direct beam	149
		MEG 1st order (2nd order skipped)	150
Switch to LEG sample and 200l/mm grating for last few low-energy points			
12.5 - 20 (50)	Si (C @ 10 deg)	Si calibration	151
		Si calibration (need to add 0.0000)	152
		direct beam	153
		Detector scan	154
		LEG 1st order	155
		LEG 2nd order	156
8.4 - 11.6(50 steps) (103 - 155)	Boron (C at 10 deg)	direct beam	157

Range: nm (eV)	Filter	Comments	File
		LEG 1st order (Note: comment field is not updated!)	158
		This replaces the bad Boron scan for LEG (72)	
		LEG 2nd order	159
Switching to HEG sample to see if arrow was marked backwards (backwards blaze could account for bad efficiency?)			
2.27 - 2.81 (150)		direct beam	160
2.702nm		HEG detector scan: 2deg to 16 deg	161
<p>Ooops... this is MEG. (As determined by peak angles on det. scan.)</p> <p>AFM will reveal whether arrow / blaze is backwards.</p> <p>End of Sunday!!! We're done.</p>			

Grating 1 (LEG) and Grating (IMP)

Grating - Filter eV - eV (steps)	G1 1stO (250 - 1300)	G1 2ndO (500 - 1300)	G2 1stO (400 - 1300)	G2 2ndO (800 - 1300)
200 - Si 66 - 100 (50)	X 155	X 156		
200 - Be 89 - 112 (20)	X 9	X 10	X 72	
200 - B 107 - 147 (50)	X 14 (158?)	X 16 (bad) 159	X 69	
	Grating Switch			
600 - B 141 - 187 (50)	X 21	X 23	X 52	
600 - C 181 - 283 (100)	X 29	X 30	X 49	X 50
600 - Ti 260 - 454 (200)			X 44	X 45
	Grating Switch			
1200 - Cr 440 - 574 (150)			X 56	X 57
1200 - Co 560 - 776 (200)			X 62, 59	X 63, 60
1200 - Cu 752 - 932 (200)				
1200 - Mg 900 - 1300 (400)				

Grating 3 and Grating 4

Grating - Filter eV - eV (steps)	G3 1stO (250 - 1300)	G3 2ndO (500 - 1300)	G4 1stO (400 - 1300)	G4 2ndO (800 - 1300)
600 - B 141 - 187 (40)	X 150			
600 - C 181 - 283 (100)	X 145	X 146		
600 - Ti 260 - 454 (200)	X 142	X 143	X 148	
	Grating Switch			
1200 - Cr 440 - 574 (150)	X 128	X 129	X 113	X 115
1200 - Co 560 - 776 (200)	X 131	X 132	X 119	X 120
1200 - Cu 752 - 932 (200)	X 134	X 135	X 122	X 123
1200 - Mg 900 - 1300 (400)			X 125	X 126

Grating 5 and Grating 6

Grating - Filter eV - eV (steps)	G5 1stO (250 - 1300)	G5 3rdO (500 - 1300)	G6 1stO (400 - 1300)	G6 3rdO (800 - 1300)
600 - Ti 260 - 454 (200)	X 104	X 105	X 100	X 101
	Grating Switch			
1200 - Cr 440 - 574 (150)	X 76	X 77	X 87	X 88
1200 - Co 560 - 776 (200)	X 79	X 80	X 90	X 91
1200 - Cu 752 - 932 (200)	X 83	X 84	X 93	X 94
1200 - Mg 900 - 1300 (400)			X 96	X 97