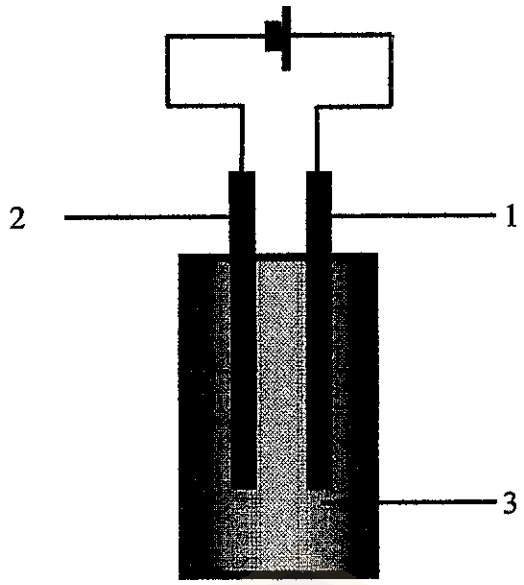
Lampiran A. Susunan alat elektrolisis



Gambar 3.1. Susunan alat elektrolisis

Keterangan Gambar:

1. Batang karbon
2. Kawat tembaga
3. Larutan elektrolit ($CuSO_4$ 1 M dengan pH 5)

Lampiran B. Hasil pengendapan Cu_2O melalui elektrolisis dengan variasi kuat arus

Tabel 4.2 Hasil pengendapan Cu_2O melalui elektrolisis dengan variasi kuat arus

Kuat Arus (A)	Massa Endapan (g)	Ciri Fisik Endapan
0,05	0,0791	Merah bata, melekat rapuh pada katode.
0,10	0,0881	Merah bata, melekat kuat pada katode.
0,15	0,1084	Merah bata, melekat kuat pada katode.
0,20	0,3135	Merah bata, melekat kuat pada katode.
0,25	0,4035	Merah bata, melekat agak rapuh pada katode.

Lampiran C. Hasil perhitungan berat endapan Cu_2O dengan variasi kuat arus

Cara perhitungan:

$M_{endapan}$ = (Massa katode sesudah elektrolisis) – (Massa katode sebelum elektrolisis)

= $M_{total} - M_{katode}$

Contoh perhitungan:

Massa katode dan endapan, M_{total}, pada elektrolisis 0,05 A adalah 0,8965 g dan massa katode awal, M_{katode} adalah 0,8174 g. Maka, massa endapan yang diperoleh:

$M_{endapan}$ = $M_{total} - M_{katode}$

= 0,8965 g – 0,8174 g

= 0,0791 g

Tabel. 4.3 Hasil perhitungan berat endapan Cu_2O dengan variasi kuat arus

Kuat arus (A)	M_{total} (g)	M_{katode} (g)	$M_{endapan}$ (g)
0,05	0,8965	0,8174	0,0791
0,10	1,1100	1,0219	0,0881
0,15	1,0149	0,7652	0,1084
0,20	1,2200	0,9065	0,3135
0,25	1,4758	1,0723	0,4035

Lampiran D. Data perbandingan nilai d difraktogram endapan hasil elektrolisis dengan difraktogram standar

Tabel 4.4 Data perbandingan nilai d difraktogram endapan hasil elektrolisis 0,05 A dengan difraktogram standar

d (Å) endapan	Data *Powder Diffraction* Standar			
	d (Å) Cu_2O	d (Å) CuO	d (Å) Cu	d (Å) $Cu(OH)_2$
2,27	-	2,31	-	2,26
2,05	-	-	2,09	-
1,97	-	-	2,09	-
1,78	1,74	-	-	-
1,40	-	1,42	-	-
1,26	1,23	-	-	-
1,19	1,23	-	-	-

Tabel 4.5 Data perbandingan nilai d difraktogram endapan hasil elektrolisis 0,10 A dengan difraktogram standar

d (Å) endapan	Data *Powder Diffraction* Standar			
	d (Å) Cu_2O	d (Å) CuO	d (Å) Cu	d (Å) $Cu(OH)_2$
2,29	-	2,31	-	2,26
2,07	-	-	2,09	-
1,99	-	-	-	-
1,79	1,74	-	-	-
1,41	1,42	-	-	-
1,40	1,42	-	-	-
1,27	-	-	1,27	-
1,20	1,23	-	-	-

Tabel 4.6 Data perbandingan nilai d difraktogram endapan hasil elektrolisis 0,15 A dengan difraktogram standar

d (Å) endapan	Data *Powder Diffraction* Standar			
	d (Å) Cu_2O	d (Å) CuO	d (Å) Cu	d (Å) $Cu(OH)_2$
2,30	-	2,31	-	-
2,08	-	-	2,09	-
2,06	-	-	2,09	-
1,99	-	-	-	-
1,80	-	-	1,81	-
1,41	1,42	-	-	-
1,27	-	-	1,27	-
1,20	1,23	-	-	-
1,08	-	1,09	-	-

Tabel 4.7 Data perbandingan nilai d difraktogram endapan hasil elektrolisis 0,25 A dengan difraktogram standar

d (Å) endapan	Data *Powder Diffraction* Standar			
	d (Å) Cu_2O	d (Å) CuO	d (Å) Cu	d (Å) $Cu(OH)_2$
8,33	-	-	-	-
8,07	-	-	-	-
7,85	-	-	-	-
7,72	-	-	-	-
7,52	-	-	-	-
7,33	-	-	-	-
7,24	-	-	-	-
6,70	-	-	-	-
6,57	-	-	-	-
4,52	-	-	-	-

2,72	-	-	-	-
2,64	-	-	-	2,64
2,33	-	-	-	-
2,31	-	2,31	-	-
2,27	-	-	-	2,27
2,26	-	-	-	2,26
2,21	2,22	-	-	-
2,13	2,12	-	-	-
2,09	-	-	-	-
2,06	-	-	-	-
2,04	-	-	-	-
2,02	-	-	-	-
1,98	-	-	-	-
1,97	-	-	-	-
1,94	-	-	-	-
1,92	-	-	-	1,92
1,90	-	-	-	-
1,86	-	1,86	-	-
1,85	-	-	-	-
1,81	-	-	1,81	-
1,79	-	1,78	-	-
1,61	-	-	-	-
1,60	-	-	-	-
1,59	-	-	-	-
1,51	-	-	-	-
1,50	-	-	-	-
1,47	-	-	-	-
1,45	-	-	-	-
1,44	-	-	-	-
1,43	-	-	-	1,43
1,42	1,42	-	-	-

1,41	1,42	-	-	-
1,40	-	-	-	-
1,39	-	-	-	-
1,38	-	-	-	-
1,35	1,35	-	-	-
1,34	-	-	-	-
1,33	-	-	-	-
1,31	-	-	-	-
1,30	1,29	-	-	-
1,28	-	-	-	1,28
1,27	-	-	1,27	-
1,26	-	-	-	-
1,25	-	-	-	-
1,23	1,23	-	-	-
1,21	-	-	-	-
1,19	-	-	-	-
1,18	-	-	-	-
1,17	-	-	-	-
1,16	-	-	-	-
1,14	-	-	-	-
1,13	-	-	-	-
1,09	-	1,09	-	-

Lampiran E. Data analisis XRD hasil elektrolisis memakai kuat arus 0,05 A

*** Basic Data Process ***

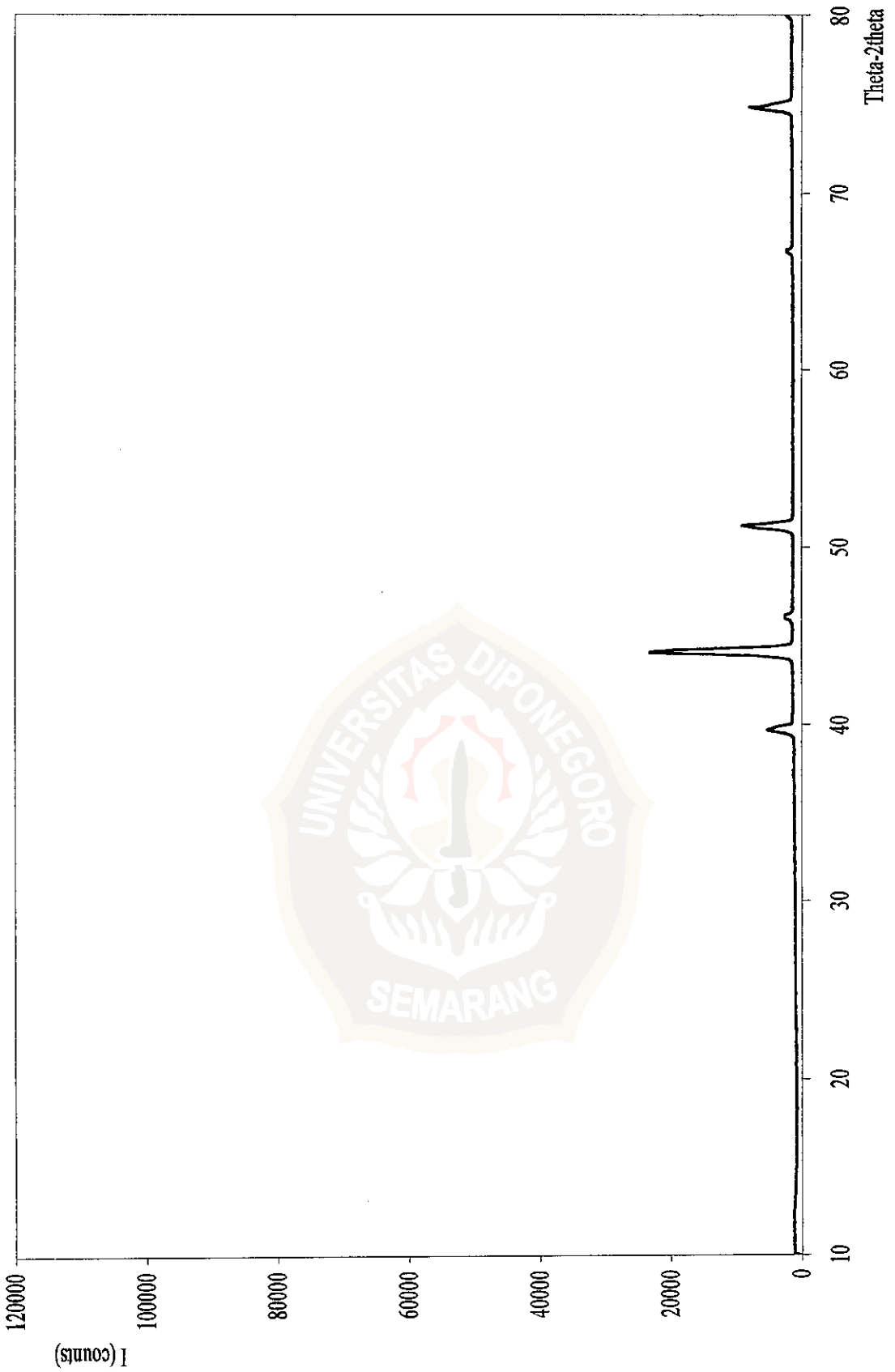
Group Name : Standard
Data Name : vivi3
File Name : vivi3.FKR
Sample Name : tembaga
Comment :

Strongest 3 peaks

no.	peak no.	2Theta (deg)	d (A)	I/I1	FWHM (deg)	Intensity (Counts)	Integrated Int (Counts)
1	2	44.0158	2.05559	100	0.43460	12180	107322
2	4	51.1207	1.78533	42	0.34970	5156	37441
3	6	74.7510	1.26895	39	0.30660	4740	31435

Peak Data List

peak no.	2Theta (deg)	d (A)	I/I1	FWHM (deg)	Intensity (Counts)	Integrated Int (Counts)
1	39.6425	2.27169	21	0.35580	2545	21196
2	44.0158	2.05559	100	0.43460	12180	107322
3	45.9438	1.97371	7	0.34300	888	7117
4	51.1207	1.78533	42	0.34970	5156	37441
5	66.6064	1.40292	6	0.28100	735	4661
6	74.7510	1.26895	39	0.30660	4740	31435
7	79.9500	1.19900	6	0.32460	777	4280



Lampiran F. Data analisis XRD hasil elektrolisis memakai kuat arus 0,10 A

*** Basic Data Process ***

Group Name : Standard
Data Name : vivi
File Name : vivi.PKR
Sample Name : tembaga
Comment :

Peak Data List

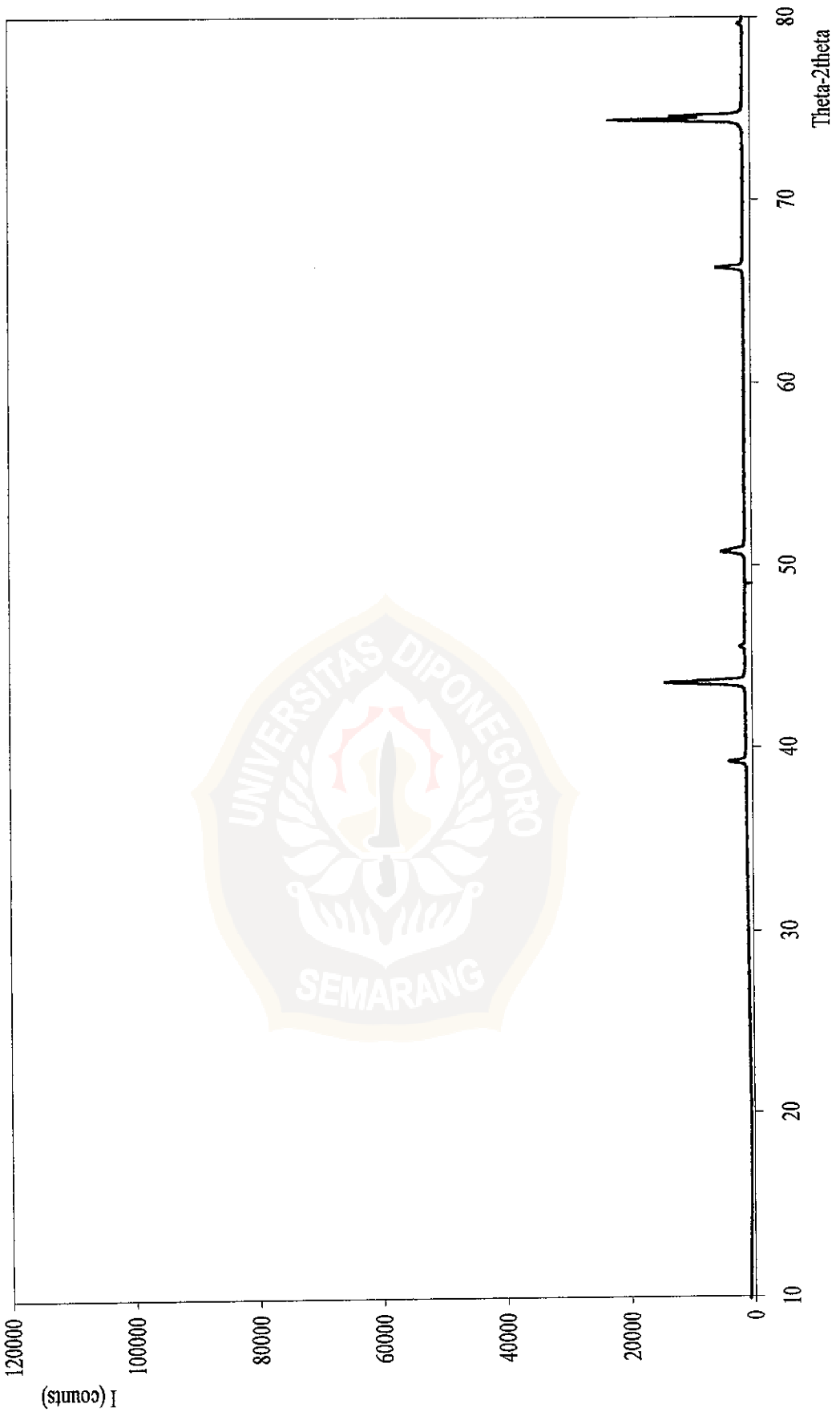
peak no.	2Theta (deg)	d (A)	I/I1	FWHM (deg)	Intensity (Counts)	Integrated Int (Counts)
1	39.1789	2.29750	21	0.15250	2256	19937
2	43.5539	2.07631	100	0.17530	10659	103820
3	45.5167	1.99123	6	0.16410	641	6171

Strongest 3 peaks

no.	peak no.	2Theta (deg)	d (A)	I/I1	FWHM (deg)	Intensity (Counts)	Integrated Int (Counts)
1	4	74.3509	1.27479	100	0.17730	17115	160875
2	2	66.2269	1.41003	24	0.15370	4067	33434
3	1	50.6905	1.79946	19	0.17410	3214	33466

Peak Data List

peak no.	2Theta (deg)	d (A)	I/I1	FWHM (deg)	Intensity (Counts)	Integrated Int (Counts)
1	50.6905	1.79946	19	0.17410	3214	33466
2	66.2269	1.41003	24	0.15370	4067	33434
3	66.6120	1.40281	5	0.12190	908	5432
4	74.3509	1.27479	100	0.17730	17115	160875
5	74.5600	1.27173	16	0.09700	2760	21025
6	79.6051	1.20332	4	0.16600	662	6211



Lampiran G. Data analisis XRD hasil elektrolisis memakai kuat arus 0,15 A

*** Basic Data Process ***

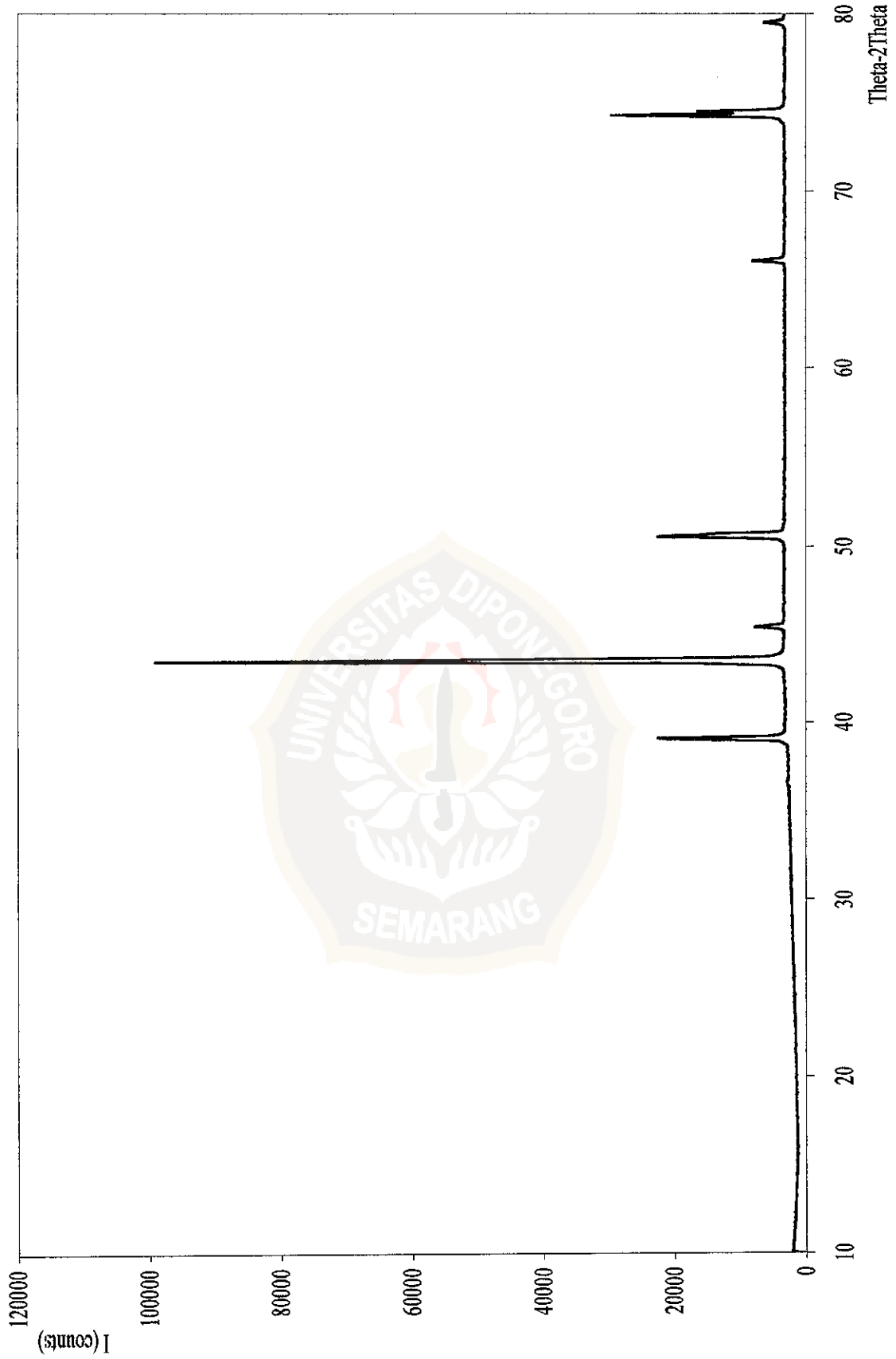
Group Name : Standard
Data Name : vivi4
File Name : vivi4.PKR
Sample Name : Tembaga Oksida
Comment :

Strongest 3 peaks

no.	peak no.	2Theta (deg)	d (A)	I/I1	FWHM (deg)	Intensity (Counts)	Integrated Int (Counts)
1	2	43.3778	2.08433	100	0.22060	56614	275166
2	7	74.2011	1.27699	38	0.15710	21782	82201
3	5	50.5238	1.80501	24	0.19470	13682	57280

Peak Data List

peak no.	2Theta (deg)	d (A)	I/I1	FWHM (deg)	Intensity (Counts)	Integrated Int (Counts)
1	38.9936	2.30799	16	0.21780	8887	43737
2	43.3778	2.08433	100	0.22060	56614	275166
3	43.7902	2.06565	4	0.08930	2160	4920
4	45.3491	1.99820	7	0.14400	3779	12455
5	50.5238	1.80501	24	0.19470	13682	57280
6	66.0637	1.41312	8	0.15950	4437	15033
7	74.2011	1.27699	38	0.15710	21782	82201
8	79.4528	1.20525	5	0.17390	2791	10497
9	89.9500	1.08984	16	0.13940	9085	29304



Lampiran H. Data analisa XRD endapan hasil elektrolisis 0,25 A

*** Basic Data Process ***

Group Name : Standard
Data Name : vivi5
File Name : vivi5.PKR
Sample Name : Tembaga Oksida
Comment :

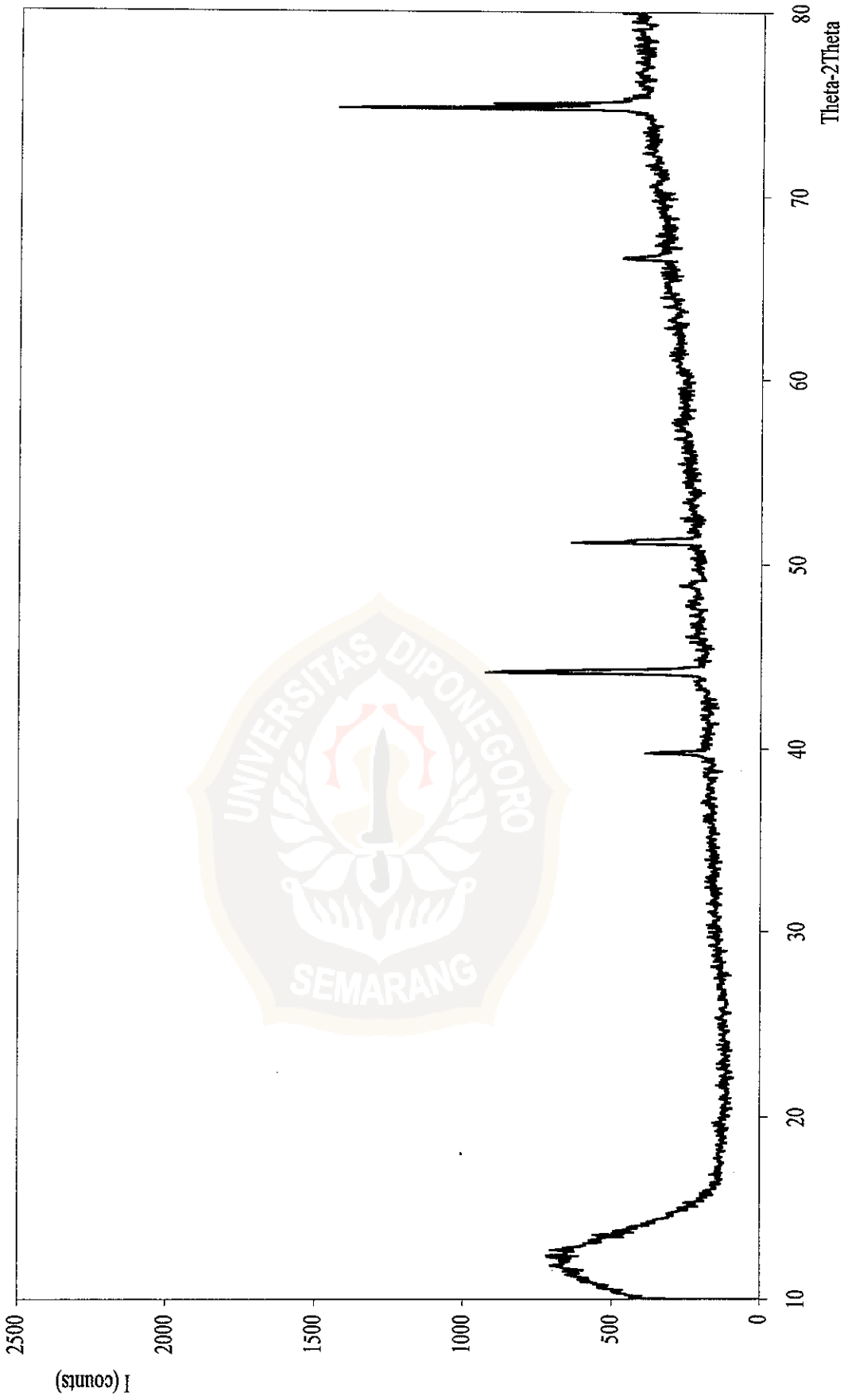
Strongest 3 peaks

no.	peak no.	2Theta (deg)	d (A)	I/I1	FWHM (deg)	Intensity (Counts)	Integrated Int (Counts)
1	65	74.7131	1.26950	100	0.14570	860	2708
2	23	44.0588	2.05368	71	0.16050	609	2121
3	34	51.1419	1.78464	38	0.15050	331	1122

Peak Data List

peak no.	2Theta (deg)	d (A)	I/I1	FWHM (deg)	Intensity (Counts)	Integrated Int (Counts)
1	10.6000	8.33923	6	0.18760	50	245
2	10.9500	8.07346	8	0.60000	68	808
3	11.2500	7.85883	11	0.00000	98	0
4	11.4500	7.72200	12	0.00000	101	0
5	11.7500	7.52551	15	0.00000	126	0
6	12.0500	7.33982	13	0.00000	108	0
7	12.2000	7.24892	16	0.00000	140	0
8	12.4000	7.13245	15	0.00000	133	0
9	12.6500	6.99205	16	0.78340	136	1753
10	13.2000	6.70192	9	0.00000	78	0
11	13.4500	6.57791	9	0.16660	79	479
12	13.7337	6.44266	7	0.35140	63	582
13	19.6223	4.52055	3	0.13080	26	127
14	32.8563	2.72371	3	0.09500	28	108
15	33.8348	2.64714	4	0.09690	32	136
16	38.4618	2.33867	4	0.11860	38	143
17	38.8266	2.31753	4	0.10170	31	82
18	39.5000	2.27956	4	0.15380	34	155
19	39.7001	2.26853	21	0.13310	182	478
20	39.9335	2.25580	4	0.08610	34	101
21	40.6122	2.21966	3	0.11720	27	121
22	43.8500	2.06298	4	0.09480	36	79
23	44.0588	2.05368	71	0.16050	609	2121
24	44.3406	2.04128	3	0.08130	30	70
25	44.7994	2.02148	4	0.07400	34	65
26	45.6499	1.98573	3	0.22650	28	150
27	45.9793	1.97227	6	0.12830	55	170
28	46.5422	1.94972	3	0.09200	26	129
29	47.1534	1.92586	3	0.11410	30	104
30	47.6214	1.90802	4	0.20120	34	139
31	47.9351	1.89627	5	0.11670	40	98
32	48.7679	1.86581	7	0.15170	57	236
33	49.0136	1.85703	3	0.08620	26	57
34	51.1419	1.78464	38	0.15050	331	1122
35	51.7351	1.76556	3	0.14240	26	182
36	53.3500	1.71586	3	0.16500	27	198
37	54.4581	1.68354	3	0.07040	27	77
38	56.7923	1.61976	4	0.14460	34	123
39	57.2436	1.60806	3	0.15650	26	110
40	57.5309	1.60071	5	0.15230	39	122
41	57.8062	1.59374	4	0.06760	33	43
42	61.0280	1.51709	3	0.12520	26	81
43	61.3566	1.50975	3	0.24100	26	139
44	62.7926	1.47863	4	0.15560	37	173
45	63.1695	1.47071	6	0.18730	54	249

peak no.	2Theta (deg)	d (A)	I/I1	FWHM (deg)	Intensity (Counts)	Integrated Int (Counts)
46	63.9458	1.45472	4	0.15830	34	116
47	64.4524	1.44450	4	0.13270	36	121
48	64.7905	1.43778	4	0.19170	34	259
49	65.5370	1.42320	5	0.09900	39	148
50	66.1327	1.41181	3	0.12110	27	113
51	66.6101	1.40285	18	0.17270	154	572
52	67.0000	1.39563	4	0.11900	34	98
53	67.3354	1.38949	5	0.17540	42	136
54	67.8641	1.37995	4	0.17170	32	126
55	69.0112	1.35978	3	0.34750	28	337
56	69.7133	1.34780	4	0.12660	35	114
57	70.3500	1.33715	4	0.22300	32	181
58	70.5500	1.33385	3	0.20000	28	162
59	71.4855	1.31867	3	0.10110	27	60
60	71.6419	1.31618	3	0.14550	27	80
61	72.2756	1.30619	4	0.16780	34	134
62	72.6531	1.30033	3	0.15880	27	90
63	73.4349	1.28841	3	0.11770	28	127
64	74.4000	1.27407	4	0.14780	34	239
65	74.7131	1.26950	100	0.14570	860	2708
66	75.2000	1.26249	7	0.12440	62	492
67	76.0190	1.25091	5	0.27800	47	359
68	76.5279	1.24385	6	0.35590	48	326
69	77.1844	1.23490	4	0.16300	33	158
70	77.8540	1.22595	4	0.08080	32	77
71	78.1508	1.22203	4	0.22440	33	164
72	78.5570	1.21673	4	0.18070	37	127
73	78.9612	1.21151	5	0.14250	47	191
74	79.4121	1.20576	6	0.16010	54	230
75	79.9483	1.19902	11	0.16600	92	376
76	81.0016	1.18606	7	0.09670	57	143
77	81.4230	1.18099	5	0.19610	43	190
78	81.8291	1.17615	5	0.10700	43	119
79	81.9906	1.17424	6	0.08130	50	122
80	82.5925	1.16721	3	0.14500	28	139
81	82.9398	1.16320	4	0.07960	32	57
82	83.7256	1.15427	4	0.29410	34	278
83	84.1569	1.14945	5	0.11960	45	124
84	84.3200	1.14764	3	0.12000	30	91
85	84.9660	1.14056	4	0.20550	34	179
86	85.4823	1.13499	5	0.11310	42	116
87	85.9080	1.13045	4	0.08400	35	135
88	88.0373	1.10852	4	0.11950	32	94
89	89.3131	1.09596	5	0.19030	45	254



Lampiran I. Daftar jenis senyawa tembaga hasil analisis XRD dengan variasi kuat arus

Tabel 4.8 Daftar jenis senyawa tembaga hasil analisis XRD dengan variasi kuat arus

kuat arus (A)	Nilai d Analisis XRD (Å)	Jenis senyawa tembaga
0,05	2,05; 1,97	Cu
	1,78; 1,26; 1,19	Cu_2O
	2,27; 1,40	CuO
	2,27	$Cu(OH)_2$
0,10	2,07; 1,27	Cu
	1,79; 1,41; 1,40; 1,20	Cu_2O
	2,29	CuO
	–	$Cu(OH)_2$
0,15	2,09	Cu
	2,08; 2,06; 1,80; 1,27	Cu_2O
	2,30; 1,08	CuO
	–	$Cu(OH)_2$
0,25	1,81; 1,27	Cu
	2,21; 2,13; 1,42; 1,41; 1,35; 1,30; 1,23	Cu_2O
	2,31; 1,86; 1,79; 1,09	CuO
	2,64; 2,27; 2,26; 1,92; 1,43; 1,28	$Cu(OH)_2$

Lampiran J. Daftar potensial reduksi standar

Tabel 4.9 Daftar potensial reduksi standar

Reaksi setengah sel	E^0 (V)
$Cu_2O + H_2O + 2e^- \rightarrow 2Cu + 2\,OH^-$	–0,361
$2H_2O + 2e^- \rightarrow H_2 + 2OH^-$	–0,830
$2H_2O \rightarrow O_2 + 4H^+ + 4e^-$	–1,230
$Cu(OH)_2 + 2e^- \rightarrow Cu + 2OH^-$	–0,224
$2Cu(OH)_2 + 2e^- \rightarrow Cu_2O + 2OH^- + H_2O$	–0,090
$2H^+ + 2e^- \rightarrow H_2$	+0,000
$Cu^{2+} + e^- \rightarrow Cu^+$	+0,158
$Cu^+ + e^- \rightarrow Cu$	+0,552
$Cu^{2+} + 2e^- \rightarrow Cu$	+0,345
$O_2 + 2H_2O + 4e^- \rightarrow 4OH^-$	+0,401
$O_2 + 4H^+ + 4e^- \rightarrow H_2O$	+1,229
$SO_4^{2-} + 4H^+ + 2e^- \rightarrow H_2SO_3 + H_2O$	+0,170