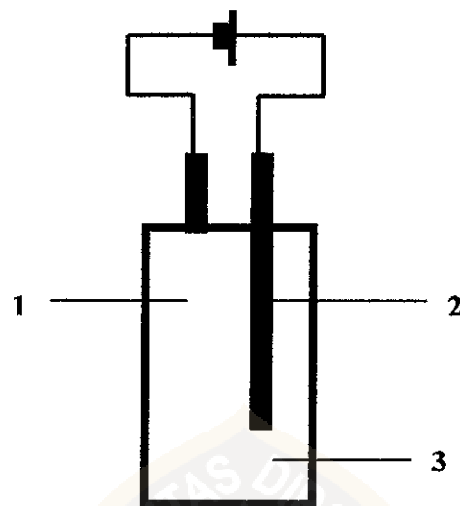


**LAMPIRAN****Lampiran A. Skema sel elektrolisis**

Gambar 3.1. Susunan alat elektrolisis

Keterangan gambar:

1. Katode: karbon
2. Anode: karbon, tembaga, timbal
3. Larutan elektrolit  $[\text{Ag}(\text{NH}_3)_2]^+$

**Lampiran B. Difraktogram hasil elektrolisis menggunakan katode karbon  
dan anode karbon**

\*\*\* Basic Data Process \*\*\*

# Data Information

Group Name : Standard  
 Data Name : retno3  
 File Name : retno3.RAW  
 Sample Name : perak  
 Comment :  
 Date & Time : 09-04-04 11:09:17

# Measurement Condition

X-ray tube  
 target : Cu  
 voltage : 40.0 (kV)  
 current : 30.0 (mA)

Slits  
 divergence slit : 1.00 (deg)  
 scatter slit : 1.00 (deg)  
 receiving slit : 0.30 (mm)

Scanning  
 drive axis : Theta-2Theta  
 scan range : 10.0000 - 90.0000 (deg)  
 scan mode : Continuous Scan  
 scan speed : 5.0000 (deg/min)  
 sampling pitch : 0.0500 (deg)  
 preset time : 0.60 (sec)

# Data Process Condition

Smoothing [ AUTO ]  
 smoothing points : 9  
 B.G.Subtraction [ AUTO ]  
 sampling points : 11  
 repeat times : 30  
 Kal-a2 Separate [ MANUAL ]  
 Kal a2 ratio : 50 (%)  
 Peak Search [ AUTO ]  
 differential points : 9  
 FWHM threshold : 0.050 (deg)  
 intensity threshold : 30 (par mil)  
 FWHM ratio (n-1)/n : 2  
 System error Correction [ NO ]  
 Precise peak Correction [ NO ]

## \*\*\* Basic Data Process \*\*\*

Group Name : Standard  
 Data Name : retno3  
 File Name : retno3.PKR  
 Sample Name : perak  
 Comment :

# Strongest 3 peaks							
no.	peak no.	2Theta (deg)	d (Å)	I/I1	FWHM (deg)	Intensity (Counts)	Integrated Int (Counts)
1	6	26.7541	3.32947	100	0.42460	5262	53205
2	11	38.4482	2.33946	86	0.24390	4506	22056
3	2	21.7013	4.09191	70	0.27710	3674	22637

# Peak Data List							
peak no.	2Theta (deg)	d (Å)	I/I1	FWHM (deg)	Intensity (Counts)	Integrated Int (Counts)	
1	19.5947	4.52681	10	0.28400	524	3452	
2	21.7013	4.09191	70	0.27710	3674	22637	
3	24.0611	3.69567	43	0.37920	2285	26338	
4	25.3500	3.51061	9	0.00000	451	0	
5	25.9000	3.43729	12	0.00000	609	0	
6	26.7541	3.32947	100	0.42460	5262	53205	
7	27.5500	3.23506	6	0.80000	302	7776	
8	28.1500	3.16746	4	0.32860	197	1813	
9	32.5691	2.74707	6	0.26180	303	1793	
10	34.6374	2.58762	22	0.23770	1148	5787	
11	38.4482	2.33946	86	0.24390	4506	22056	
12	40.1558	2.24383	12	0.24230	608	4064	
13	42.7536	2.11331	6	0.45120	332	3883	
14	43.2500	2.09020	4	0.00000	220	0	
15	43.6000	2.07422	5	0.00000	289	0	
16	43.9500	2.05851	6	0.00000	328	0	
17	44.6368	2.02842	44	0.27530	2321	16230	
18	45.4500	1.99400	4	0.58000	195	4063	
19	46.5059	1.95116	3	0.37660	161	1703	
20	54.2500	1.68950	4	0.37500	186	2573	
21	54.7614	1.67493	12	0.65470	620	7921	
22	57.8971	1.59145	7	0.22010	394	2113	
23	64.7606	1.43837	21	0.25340	1114	5910	
24	69.0929	1.35838	9	0.25000	469	2869	
25	77.7047	1.22793	33	0.27960	1747	11748	
26	81.8211	1.17625	7	0.26360	368	2437	
27	83.8040	1.15339	6	0.58500	305	5611	

**Lampiran C. Difraktogram hasil elektrolisis menggunakan katode karbon  
dan anode tembaga**

\*\*\* Basic Data Process \*\*\*

# Data Information

Group Name : Standard  
Data Name : retno2  
File Name : retno2.RAW  
Sample Name : perak  
Comment :  
Date & Time : 09-04-04 10:50:25

# Measurement Condition

X-ray tube  
target : Cu  
voltage : 40.0 (kV)  
current : 30.0 (mA)

Slits  
divergence slit : 1.00 (deg)  
scatter slit : 1.00 (deg)  
receiving slit : 0.30 (mm)

Scanning  
drive axis : Theta-2Theta  
scan range : 10.0000 - 90.0000 (deg)  
scan mode : Continuous Scan  
scan speed : 5.0000 (deg/min)  
sampling pitch : 0.0500 (deg)  
preset time : 0.60 (sec)

# Data Process Condition

Smoothing [ AUTO ]  
smoothing points : 9  
B.G.Subtraction [ AUTO ]  
sampling points : 11  
repeat times : 30  
Kal-a2 Separate [ MANUAL ]  
Kal a2 ratio : 50 (%)  
Peak Search [ AUTO ]  
differential points : 9  
FWHM threshold : 0.050 (deg)  
intensity threshold : 30 (par mil)  
FWHM ratio (n-1)/n : 2  
System error Correction [ NO ]  
Precise peak Correction [ NO ]

## \*\*\* Basic Data Process \*\*\*

Group Name : Standard  
 Data Name : retno2  
 File Name : retno2.PKR  
 Sample Name : perak  
 Comment :

# Strongest 3 peaks							
no.	peak no.	2Theta (deg)	d (A)	I/I1	FWHM (deg)	Intensity (Counts)	Integrated Int (Counts)
1	14	27.1540	3.28134	100	0.43870	5279	60477
2	18	38.8334	2.31714	37	0.25110	1960	10222
3	11	24.4967	3.63093	29	0.50270	1541	21781

# Peak Data List							
peak no.	2Theta (deg)	d (A)	I/I1	FWHM (deg)	Intensity (Counts)	Integrated Int (Counts)	
1	11.1500	7.92909	3	1.02780	167	4345	
2	11.7500	7.52551	4	0.00000	226	0	
3	12.1500	7.27864	5	0.00000	245	0	
4	12.7000	6.96463	5	0.00000	269	0	
5	13.2500	6.67675	4	0.00000	208	0	
6	13.7000	6.45843	4	0.00000	190	0	
7	14.0000	6.32070	4	0.00000	199	0	
8	14.4000	6.14602	3	1.73760	176	5893	
9	19.9430	4.44853	3	0.33830	168	1291	
10	22.0816	4.02229	17	0.31140	882	6444	
11	24.4967	3.63093	29	0.50270	1541	21781	
12	25.2000	3.53117	8	0.00000	409	0	
13	25.9000	3.43729	9	0.00000	489	0	
14	27.1540	3.28134	100	0.43870	5279	60477	
15	28.1500	3.16746	5	0.87200	248	8662	
16	35.0279	2.55966	9	0.24330	486	2465	
17	36.2912	2.47341	3	0.26550	175	1516	
18	38.8334	2.31714	37	0.25110	1960	10222	
19	40.5456	2.22315	5	0.27230	270	2794	
20	43.1500	2.09481	4	0.56200	206	3277	
21	43.5500	2.07649	4	0.00000	192	0	
22	43.8000	2.06522	4	0.00000	203	0	
23	44.2000	2.04745	5	0.00000	256	0	
24	44.6000	2.03001	5	0.00000	255	0	
25	45.0081	2.01255	21	0.29410	1105	6648	
26	45.5000	1.99193	4	0.88580	188	5172	
27	55.1060	1.66527	8	0.64990	430	8090	
28	58.2455	1.58276	3	0.23230	165	871	
29	65.1060	1.43157	11	0.24800	583	3120	
30	69.3960	1.35318	4	0.33040	203	1808	
31	78.0179	1.22378	17	0.33060	880	7539	
32	82.1190	1.17273	3	0.27360	183	1211	
33	84.0693	1.15042	4	0.82130	233	4960	

**Lampiran D. Difraktogram hasil elektrolisis menggunakan katode karbon  
dan anode timbal**

\*\*\* Basic Data Process \*\*\*

# Data Information

Group Name : Standard  
Data Name : retno  
File Name : retno.RAW  
Sample Name : perak  
Comment :  
Date & Time : 08-31-04 09:28:43

# Measurement Condition

X-ray tube  
target : Cu  
voltage : 40.0 (kV)  
current : 30.0 (mA)

Slits  
divergence slit : 1.00 (deg)  
scatter slit : 1.00 (deg)  
receiving slit : 0.30 (mm)

Scanning  
drive axis : Theta-2Theta  
scan range : 5.0000 - 50.0000 (deg)  
scan mode : Continuous Scan  
scan speed : 5.0000 (deg/min)  
sampling pitch : 0.0200 (deg)  
preset time : 0.24 (sec)

# Data Process Condition

Smoothing [ AUTO ]  
smoothing points : 11  
B.G.Subtraction [ AUTO ]  
sampling points : 11  
repeat times : 30  
Kal-a2 Separate [ MANUAL ]  
Kal a2 ratio : 50 (%)  
Peak Search [ AUTO ]  
differential points : 9  
FWHM threshold : 0.050 (deg)  
intensity threshold : 30 (par mil)  
FWHM ratio (n-1)/n : 2  
System error Correction [ NO ]  
Precise peak Correction [ NO ]

## \*\*\* Basic Data Process \*\*\*

Group Name : Standard  
 Data Name : retno  
 File Name : retno.PKR  
 Sample Name : perak  
 Comment :

# Strongest 3 peaks

no.	peak no.	2Theta (deg)	d (Å)	I/I1	FWHM (deg)	Intensity (Counts)	Integrated Int (Counts)
1	26	38.4620	2.33865	100	0.16550	2190	20048
2	31	44.6426	2.02817	61	0.17840	1336	13410
3	22	26.7568	3.32914	59	0.40920	1284	23211

# Peak Data List

peak no.	2Theta (deg)	d (Å)	I/I1	FWHM (deg)	Intensity (Counts)	Integrated Int (Counts)
1	6.3000	14.01815	3	1.17340	69	2388
2	6.4800	13.62916	3	0.00000	76	0
3	6.6600	13.26120	3	1.06000	66	1942
4	7.6200	11.59252	3	0.82500	68	2059
5	7.9800	11.07033	3	0.00000	66	0
6	8.3000	10.64423	4	0.00000	79	0
7	8.6000	10.27358	4	0.00000	83	0
8	8.8800	9.95026	5	0.44000	99	2045
9	9.1400	9.66778	4	0.00000	78	0
10	9.4200	9.38104	4	1.29000	79	5327
11	19.5474	4.53766	3	0.33050	71	1675
12	21.6903	4.09396	17	0.30590	369	6993
13	23.6600	3.75740	4	0.15420	79	1167
14	23.9400	3.71409	11	0.28000	249	4041
15	24.1000	3.68979	16	0.00000	355	0
16	24.2200	3.67178	14	0.19860	308	4179
17	25.4800	3.49299	3	0.26000	76	2335
18	25.7600	3.45566	5	0.00000	112	0
19	25.9200	3.43469	7	0.00000	161	0
20	26.1400	3.40628	9	0.00000	197	0
21	26.4000	3.37332	19	0.45340	422	8261
22	26.7568	3.32914	59	0.40920	1284	23211
23	27.3200	3.26177	4	0.16000	80	1234
24	32.6156	2.74326	4	0.12880	88	773
25	34.6543	2.58540	28	0.14390	618	5061
26	38.4620	2.33865	100	0.16550	2190	20048
27	40.1662	2.24327	18	0.15440	389	3739
28	42.7026	2.11571	4	0.16270	78	1388
29	43.9591	2.05811	4	0.29170	81	2118
30	44.3000	2.04306	3	0.21000	69	1044
31	44.6426	2.02817	61	0.17840	1336	13410

**Lampiran E. Berat endapan perak hasil elektrolisis menggunakan katode karbon dan anode karbon.**

Tabel 1. Berat endapan perak hasil elektrolisis menggunakan katode karbon dan anode karbon

Arus (mA)	$W_{obs}$ (gram)	$W_{calc}$ (gram)	$\eta$
0,2	0,0039	0,0016	243,75 %
0,4	0,0025	0,0032	78,13 %
0,6	0,0032	0,0048	66,67 %
0,8	0,0036	0,0064	56,25 %
1,0	0,0058	0,0081	71,60 %

**Lampiran F. Berat endapan perak hasil elektrolisis menggunakan katode karbon dan anode tembaga.**

Tabel 2. Berat endapan perak hasil elektrolisis menggunakan katode karbon dan anode tembaga

Arus (mA)	$W_{obs}$ (gram)	$W_{calc}$ (gram)	$\eta$
0,2	0,0009	0,0016	56,25 %
0,4	0,0021	0,0032	65,63 %
0,6	0,0020	0,0048	41,67 %
0,8	0,0037	0,0064	57,81 %
1,0	0,0048	0,0081	60,00 %



**Lampiran G. Berat endapan perak hasil elektrolisis menggunakan katode karbon dan anode timbal**

Tabel 3. Berat endapan perak hasil elektrolisis menggunakan katode karbon dan anode timbal

Arus (mA)	$W_{obs}$ (gram)	$W_{calc}$ (gram)	$\eta$
0,2	0,0015	0,0016	93,75 %
0,4	0,0020	0,0032	62,51 %
0,6	0,0024	0,0048	50,00 %
0,8	0,0042	0,0064	65,63 %
1,0	0,0060	0,0081	74,07 %

**Lampiran H. Perhitungan berat endapan perak hasil elektrolisis.**

Cara perhitungan:

$$\begin{aligned}
 W_{obs} &= \text{berat endapan perak} \\
 &= (\text{berat katode setelah dielektrolisis}) - (\text{berat katode awal}) \\
 &= W_{c2} - W_{c1}
 \end{aligned}$$

Contoh perhitungan:

Berat katode setelah dielektrolisis dengan pasangan elektrode karbon–karbon pada arus 0,4 mA,  $W_{c2}$  adalah 1,4580 gram dan berat katode awal,  $W_{c1}$  adalah 1,4553 gram. Maka berat endapan perak yang diperoleh adalah:

$$\begin{aligned}
 W_{obs} &= W_{c2} - W_{c1} \\
 &= 1,4580 \text{ gram} - 1,4553 \text{ gram} \\
 &= 0,0025 \text{ gram.}
 \end{aligned}$$

Perhitungan yang sama dilakukan untuk pasangan elektrode karbon–tembaga dan karbon–timbal.

### Lampiran I. Perhitungan berat endapan perak secara teoritis

Cara perhitungan:

$$\begin{aligned} W_{\text{calc}} &= \text{berat teoritis} \\ &= e i t \end{aligned}$$

Contoh perhitungan:

Untuk Ag(I) besar nilai e adalah  $1,1180 \cdot 10^{-3}$  g/C dan t selama 2 jam adalah 7200 s. Maka berat teoritis untuk endapan perak hasil elektrolisis dengan pasangan elektrode karbon–karbon pada arus 0,4 mA adalah:

$$\begin{aligned} W_{\text{calc}} &= e i t \\ &= 1,1180 \cdot 10^{-3} \text{ g/C} \times 0,0004 \text{ A} \times 7200 \text{ s} \\ &= 0,0032 \text{ gram.} \end{aligned}$$

Perhitungan yang sama dilakukan untuk pasangan elektrode karbon–tembaga dan karbon–timbal.

### Lampiran J. Perhitungan efisiensi elektrolisis.

Cara perhitungan:

$$\begin{aligned} \eta &= \text{efisiensi elektrolisis} \\ &= \frac{W_{\text{obs}}}{W_{\text{calc}}} \times 100\% \end{aligned}$$

Contoh perhitungan:

Berat endapan perak hasil elektrolisis pasangan elektrode karbon–karbon pada arus 0,4 mA,  $W_{\text{obs}}$  adalah 0,0025 gram, Berat teoritis,  $W_{\text{calc}}$  adalah 0,0032 gram, maka efisiensi elektrolisis,  $\eta$  adalah:

$\eta$  = efisiensi elektrolisis

$$= \frac{W_{obs}}{W_{calc}} \times 100\%$$

$$= \frac{0,0025}{0,0032} \times 100\%$$

$$= 78,13\%$$

Perhitungan yang sama dilakukan untuk pasangan elektrode karbon–tembaga dan karbon–timbal.

