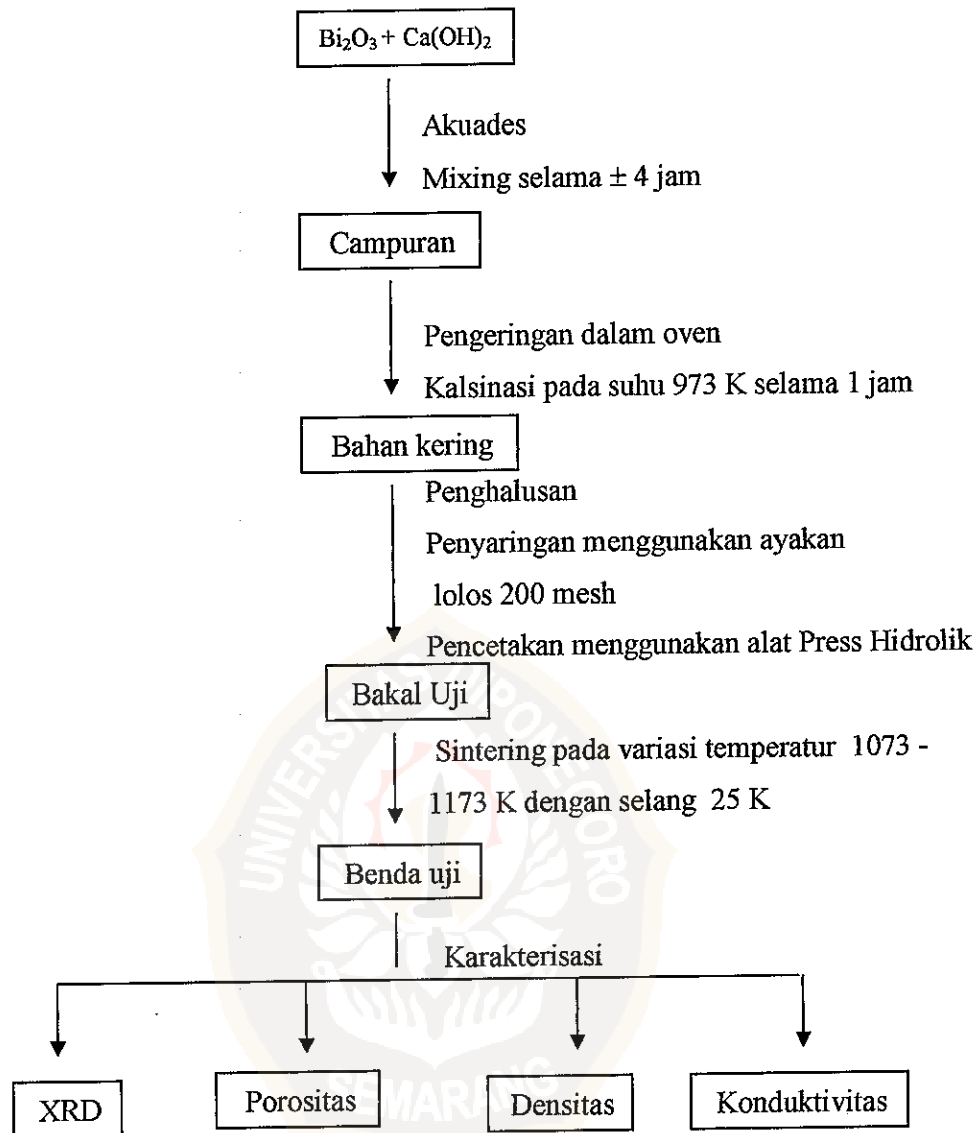


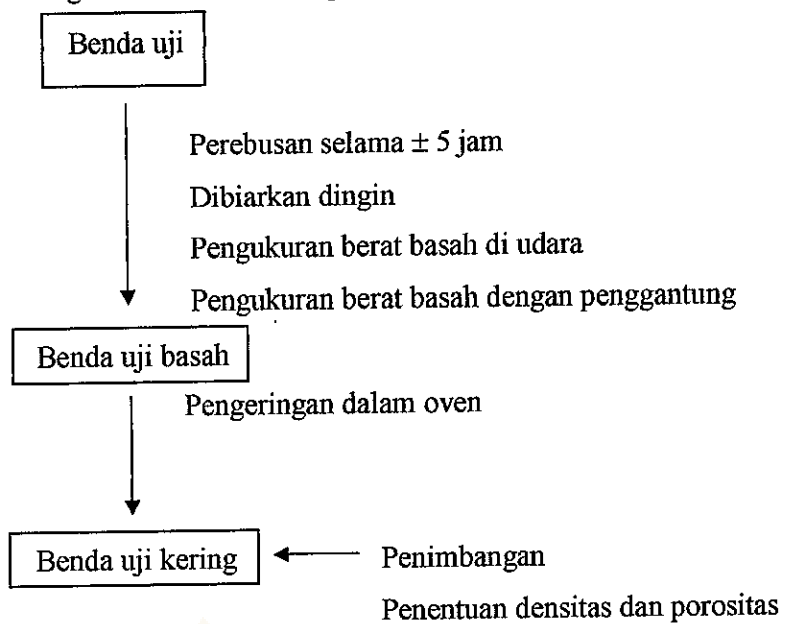
LAMPIRAN A

Bagan kerja pembuatan elektrolit padat

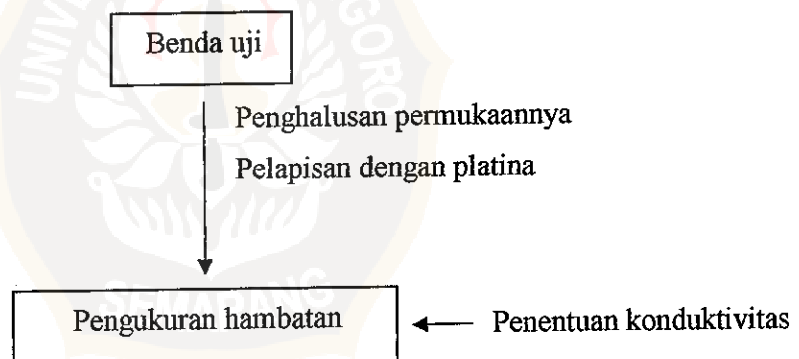


Bagan kerja karakterisasi benda uji

a. Pengukuran densitas dan porositas



b. Pengukuran Konduktivitas bahan



LAMPIRAN B

Tabel 4.2. Data perhitungan desitas dan porositas sampel dengan waktu sinter 7 jam

No	T. Sinter (K)	Berat Kering (g)	Berat Basah (g)	Berat Gantung (g)	Berat Kawat (g)	Densitas (g/cm ³)	Porositas (%)
1	1073	2,6828	2,7127	2,4008	0,0562	7,29	8,12
2	1098	0,5314	0,5370	0,5121	0,0465	7,44	7,84
3	1123	2,4827	2,5060	2,2645	0,0862	7,52	7,11
4	1148	1,9285	1,9392	1,7348	0,0501	7,57	4,20

Tabel 4.3. Data perhitungan desitas dan porositas sampel dengan waktu sinter 10 jam

No	T. Sinter (K)	Berat Kering (g)	Berat Basah (g)	Berat Gantung (g)	Berat Kawat (g)	Densitas (g/cm ³)	Porositas (%)
1	1073	1,9309	1,9521	1,7434	0,0620	7,13	7,83
2	1098	2,2319	2,2428	1,9708	0,0409	7,13	3,48

Perhitungan berat Bi₂O₃ dan Ca(OH)₂ yang digunakan

Misal: Fraksi mol total yang digunakan = 0,03 mol

Fraksi mol Bi₂O₃ (80 %) = 0,024 mol

$$\begin{aligned} \text{Berat yang dibutuhkan} &= \text{mol} \times \text{Mr Bi}_2\text{O}_3 \\ &= 0,024 \text{ mol} \times 465,92 \text{ g/mol} \\ &= 11,1820 \text{ g} \end{aligned}$$

Fraksi mol CaO (20 %) = 0,06 mol

Fraksi mol Ca(OH)₂ ≈ Fraksi mol CaO

$$\begin{aligned} \text{Berat Ca(OH)}_2 \text{ yang dibutuhkan} &= \text{mol} \times \text{Mr Ca(OH)}_2 \\ &= 0,06 \text{ mol} \times 74,08 \text{ g/mol} \\ &= 0,4448 \text{ g} \end{aligned}$$

LAMPIRAN C

Tabel. 4.4. Data hasil XRD elektrolit dengan sinter 1073 K, selama 7 jam.

No	2 θ	d	Senyawa
1	28,8	3,903	Bi ₁₄ Ca ₅ O ₂₆
2	28,7	3,106	Bi ₁₄ Ca ₅ O ₂₆
3	27,9	3,196	β -Bi ₂ O ₃
4	5,95	1,670	β -Bi ₂ O ₃
5	30,5	2,928	β -Bi ₂ O ₃
6	45,7	1,985	β -Bi ₂ O ₃
7	26,72	3,334	α -Bi ₂ O ₃
8	49,92	1,825	α -Bi ₂ O ₃
9	32,20	2,780	β -Bi ₂ O ₃
10	34,27	2,611	β -Bi ₂ O ₃

Tabel. 4.5. Data hasil XRD elektrolit dengan sinter 1098 K, selama 7 jam

No	2 θ	d	Senyawa
1	16,72	5,312	α -Bi ₂ O ₃
2	27,47	3,250	α -Bi ₂ O ₃
3	25,15	3,533	α -Bi ₂ O ₃
4	25,42	3,501	α -Bi ₂ O ₃
5	18,45	4,814	-
6	29,02	3,081	Bi ₁₄ Ca ₅ O ₂₆
7	33,12	2,702	α -Bi ₂ O ₃
8	28,05	3,183	α -Bi ₂ O ₃
9	25,70	3,469	α -Bi ₂ O ₃
10	30,60	2,917	-

Tabel.4.6. Data hasil XRD elektrolit dengan sinter 1123 K, selama 7 jam

No	2 θ	D	Senyawa
1	29,20	3,057	Bi ₁₄ Ca ₅ O ₂₆
2	29,10	3,069	Bi ₁₄ Ca ₅ O ₂₆
3	29,40	3,033	Bi ₁₄ Ca ₅ O ₂₆
4	31,00	2,885	δ -Bi ₂ O ₃
5	55,40	1,656	δ -Bi ₂ O ₃
6	46,20	1,965	β -Bi ₂ O ₃
7	53,50	1,712	δ -Bi ₂ O ₃
8	50,40	1,808	β -Bi ₂ O ₃
9	61,33	1,500	β -Bi ₂ O ₃
10	37,00	2,429	-

Tabel. 4.7. Data hasil XRD elektrolit dengan sinter 1148 K, selama 7 jam

No	2 θ	D	Senyawa
1	28,07	3,106	Bi ₁₄ Ca ₅ O ₂₆
2	27,30	3,263	δ -Bi ₂ O ₃
3	26,77	3,334	β -Bi ₂ O ₃
4	30,57	2,917	β -Bi ₂ O ₃
5	32,97	2,712	δ -Bi ₂ O ₃
6	27,97	3,183	δ -Bi ₂ O ₃
7	26,05	3,423	β -Bi ₂ O ₃
8	45,72	1,985	β -Bi ₂ O ₃
9	54,97	,670	δ -Bi ₂ O ₃
10	49,67	1,834	β -Bi ₂ O ₃

LAMPIRAN D

Tabel 4.8. Data pengukuran konduktivitas sampel dengan sintering 1073 K selama 7 jam

T (°C)	R total (ohm)	R kwt (ohm)	R sampel (ohm)	r sampel (ohm.cm)	σ (S/cm)
25	80530000	0.13	80529999.87	270085217.9	3.70254×10^{-9}
30	73220000	0.13	73219999.87	245568603.7	4.07218×10^{-9}
40	54310000	0.13	54309999.87	182147375.8	5.49006×10^{-9}
50	22740000	0.13	22739999.87	76266457.6	1.31119×10^{-8}
60	13340000	0.13	13339999.87	44740305.2	2.23510×10^{-8}
70	10250000	0.13	10249999.87	34376921.06	2.90893×10^{-8}
80	8540000	0.13	8539999.87	28641844.4	3.49140×10^{-8}
90	5790000	0.13	5789999.87	19418767.9	5.14966×10^{-8}
100	5660000	0.13	5659999.87	18982767.92	5.26794×10^{-8}
110	5020000	0.13	5019999.87	16836306.48	5.93955×10^{-8}
120	3210000	0.13	3209999.87	10765845.22	9.28863×10^{-8}
130	2860000	0.13	2859999.87	9591999.124	1.04254×10^{-7}
140	2730000	0.13	2729999.87	9155999.144	1.09218×10^{-7}
150	2511000	0.13	2510999.87	8421506.87	1.18744×10^{-7}
160	2253100	0.13	2253099.87	7556549.987	1.32336×10^{-7}
170	2023000	0.13	2022999.87	6784830.022	1.47388×10^{-7}
180	1270000	0.13	1269999.87	4259383.984	2.34776×10^{-7}
190	1120000	0.13	1119999.87	3756307.084	2.66219×10^{-7}
200	987000	0.13	986999.87	3310245.566	3.02092×10^{-7}
210	885000	0.14	884999.86	2968153.24	3.36910×10^{-7}
220	731000	0.14	730999.86	2652891.716	3.76947×10^{-7}
230	706000	0.14	705999.86	2367814.806	4.22330×10^{-7}
240	623000	0.14	622999.86	2089445.588	4.78596×10^{-7}
250	554000	0.14	553999.86	1858030.214	5.38204×10^{-7}
260	503000	0.14	502999.86	1686984.068	5.92774×10^{-7}
270	460000	0.14	459999.86	1542768.69	6.48185×10^{-7}
280	425000	0.14	424999.86	1425384.08	7.01565×10^{-7}
290	391000	0.14	390999.86	1311353.316	7.62571×10^{-7}
300	352000	0.14	351999.86	1180553.322	8.47060×10^{-7}
310	312000	0.14	311999.86	1046399.482	9.55658×10^{-7}
320	273000	0.14	272999.86	915599.4885	1.09210×10^{-6}
330	261000	0.14	260999.86	875353.3365	1.14240×10^{-6}
340	259000	0.14	258999.86	868645.6445	1.15122×10^{-6}
350	256000	0.14	255999.86	858584.4165	1.16471×10^{-6}
360	255000	0.14	254999.86	855230.2605	1.16928×10^{-6}
370	230000	0.14	229999.86	771384.1105	1.29637×10^{-6}
380	200000	0.14	199999.86	670768.7305	1.49083×10^{-6}
390	164000	0.14	163999.86	550030.2745	1.81808×10^{-6}
400	92000	0.14	91999.86	308553.3625	3.24093×10^{-6}

Tabel 4.9. Data pengukuran konduktivitas sampel dengan sintering 1098 K selama 7 jam

T (°C)	R total (ohm)	R kwt (ohm)	R sampel (ohm)	r sampel (ohm.cm)	σ (S/cm)
25	33560000	0.13	33559999.87	338826921.9	2.95136×10^{-9}
30	33400000	0.13	33399999.87	337211537.3	2.96550×10^{-9}
40	33320000	0.13	33319999.87	336403845	2.97262×10^{-9}
50	33120000	0.13	33119999.87	33438614.2	2.99057×10^{-9}
60	33010000	0.13	33009999.87	333274037.3	3.00053×10^{-9}
70	32950000	0.13	32949999.87	332668268	3.00600×10^{-9}
80	32880000	0.13	32879999.87	331961537.3	3.12400×10^{-9}
90	32880000	0.13	32879999.87	331961537.3	3.12400×10^{-9}
100	32850000	0.13	32849999.87	331658652.7	3.01515×10^{-9}
110	32020000	0.13	32019999.87	323278845	3.09330×10^{-9}
120	31830000	0.13	31829999.87	321360575.7	3.11177×10^{-9}
130	31620000	0.13	31619999.87	319240383.4	3.13939×10^{-9}
140	31550000	0.13	31549999.87	318533652.7	3.13939×10^{-9}
150	30980000	0.13	30979999.87	312778845	3.19715×10^{-9}
160	30770000	0.13	30769999.87	310658652.7	3.21897×10^{-9}
170	30110000	0.13	30109999.87	303995191.1	3.28953×10^{-9}
180	29470000	0.13	29469999.87	297533652.6	3.36096×10^{-9}
190	25980000	0.13	25979999.87	262298075.7	3.81246×10^{-9}
200	22540000	0.13	22539999.87	227567306.5	4.39430×10^{-9}
210	18620000	0.14	18619999.86	187990383.3	5.31942×10^{-9}
220	14460000	0.14	14459999.86	145990383.3	6.84977×10^{-9}
230	11640000	0.14	11639999.86	117519229.4	8.50925×10^{-9}
240	9037000	0.14	9036999.86	91238940.93	1.09602×10^{-8}
250	7431000	0.14	7430999.86	75024517.85	1.33290×10^{-8}
260	6388000	0.14	6387999.86	64494229.38	1.55053×10^{-8}
270	54320000	0.14	5341999.86	53933652.45	1.85413×10^{-8}
280	4471000	0.14	4470999.86	45139902.45	2.21533×10^{-8}
290	3861000	0.14	3860999.86	38981248.6	2.56534×10^{-8}
300	3354000	0.14	3353999.86	33862498.6	2.95312×10^{-8}
310	2982000	0.14	2981999.86	30106729.37	3.32152×10^{-8}
320	2625000	0.14	2624999.86	26502402.44	3.77324×10^{-8}
330	2309000	0.14	2308999.86	23312017.83	4.28963×10^{-8}
340	534000	0.14	533999.86	5391344.742	1.85482×10^{-7}
350	438000	0.14	437999.86	4422113.973	2.26136×10^{-7}
360	3784000	0.14	378399.86	3820383.203	2.61754×10^{-7}
370	331400	0.14	331399.86	3345863.972	2.98876×10^{-7}
380	281300	0.14	281299.86	2840046.665	3.52107×10^{-7}
390	124100	0.14	124099.86	1252931.279	7.98128×10^{-7}
400	102100	0.14	102099.86	1030815.895	9.70105×10^{-7}

Tabel 4.10. Data pengukuran konduktivitas sampel dengan sintering 1123 K selama 7 jam

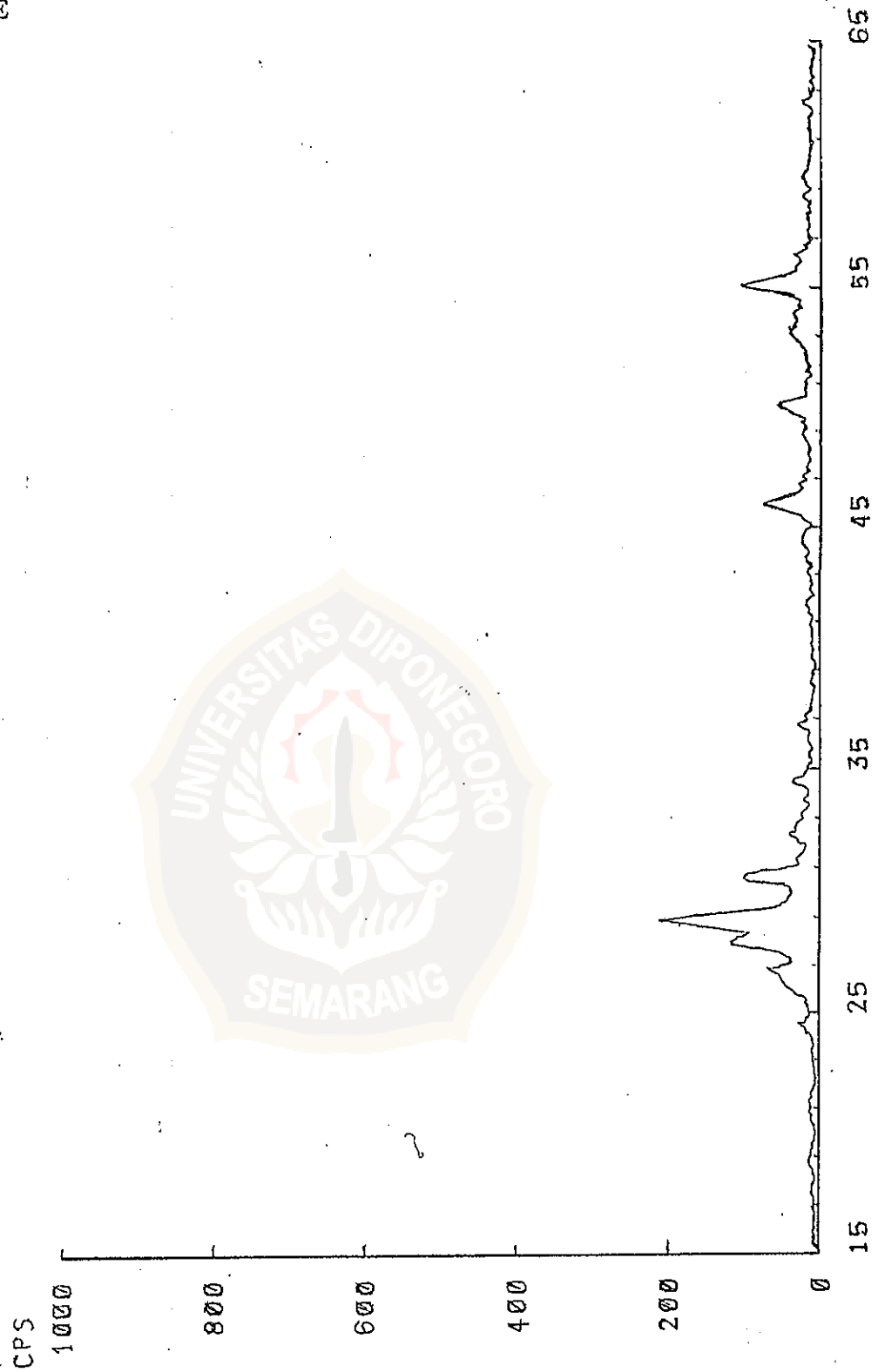
T ($^{\circ}\text{C}$)	R total (ohm)	R kwt + sampel (ohm)	R sampel (ohm)	r sampel (ohm.cm)	σ (S/cm)
25	57089000	0.13	57088999.87	138770182.5	7.20610×10^{-9}
30	56271000	0.13	56270999.87	136781813.3	7.31091×10^{-9}
40	53420000	0.13	53419999.87	129851690.3	7.70109×10^{-9}
50	48534000	0.13	48533999.87	117974952	8.47638×10^{-9}
60	44875000	0.13	44874999.87	109080767.5	9.16752×10^{-9}
70	40092000	0.13	40091999.87	97454398.45	1.02612×10^{-8}
80	34671000	0.13	34670999.87	84277198.62	1.18656×10^{-8}
90	26515000	0.13	26514999.87	64451845.02	1.55155×10^{-8}
100	21480000	0.13	21479999.87	52212922.1	1.91523×10^{-8}
110	17771000	0.13	17770999.87	43197199.14	2.31496×10^{-8}
120	12998000	0.13	12997999.87	31595137.75	3.16504×10^{-8}
130	8550000	0.13	8549999.87	20783076.34	4.81161×10^{-8}
140	6376000	0.13	63759999.87	15498584.1	6.45220×10^{-8}
150	5295000	0.13	5294999.87	1270922.6	7.76945×10^{-8}
160	4155000	0.13	4154999.87	10099845.71	9.90114×10^{-8}
170	3675000	0.13	3674999.87	8933076.494	1.11944×10^{-7}
180	3035000	0.13	3034999.87	7377384.206	1.35549×10^{-7}
190	2480000	0.13	2479999.87	6028307.3	1.65884×10^{-7}
200	2065000	0.13	2064999.87	5019538.082	1.99222×10^{-7}
210	1267000	0.14	1266999.86	3079784.236	3.24698×10^{-7}
220	1088000	0.14	1087999.86	2644676.549	3.78118×10^{-7}
230	922000	0.14	921999.86	2241168.862	4.46196×10^{-7}
240	755000	0.14	754999.86	1835230.406	5.44891×10^{-7}
250	624000	0.14	623999.86	1516799.64	6.59283×10^{-7}
260	517000	0.14	516999.86	1256707.336	7.95730×10^{-7}
270	425000	0.14	424999.86	1033076.57	9.67982×10^{-7}
280	372000	0.14	371999.86	904245.8021	1.10589×10^{-6}
290	316000	0.14	315999.86	768122.7269	1.30188×10^{-6}
300	284000	0.14	283999.86	690338.1125	1.44857×10^{-6}
310	246000	0.14	245999.86	597968.8829	1.67233×10^{-6}
320	214000	0.14	213999.86	520184.2685	1.92240×10^{-6}
330	136742	0.14	136741.86	332387.9016	3.00853×10^{-6}
340	120775	0.14	120774.86	293575.8098	3.40628×10^{-6}
350	106605	0.14	106604.86	259131.8103	3.85904×10^{-6}
360	89496	0.14	89485.86	217519.4723	4.59729×10^{-6}
370	72288	0.14	72287.86	175715.1036	5.69103×10^{-6}
380	53617	0.14	53616.86	130330.2119	7.67282×10^{-6}
390	32625	0.14	32624.86	79305.50484	1.26098×10^{-5}
400	12571	0.14	12570.86	30556.85931	3.27259×10^{-5}

Tabel 4.11. Data pengukuran konduktivitas sampel dengan sintering 1148 K selama 7 jam

T (°C)	R total (ohm)	R kwt (ohm)	R sampel (ohm)	r sampel (ohm.cm)	σ (S/cm)
25	32860000	0.13	32859999.87	202758357.4	4.93198×10^{-9}
30	32640000	0.13	32639999.87	201400876	4.96522×10^{-9}
40	32530000	0.13	32529999.87	200722135.3	4.98201×10^{-9}
50	31940000	0.13	31939999.87	197081617	5.07404×10^{-9}
60	3082000	0.13	30819999.87	190170802.6	5.25843×10^{-9}
70	30840000	0.13	30839999.87	190294210	5.25502×10^{-9}
80	30410000	0.13	30409999.87	187640950.9	5.32933×10^{-9}
90	3350000	0.13	3349999.87	20670738.7	4.83776×10^{-8}
100	30120000	0.13	30119999.87	185851543.6	5.38064×10^{-9}
110	2965000	0.13	29649999.87	182951469.7	5.46593×10^{-9}
120	29120000	0.13	29119999.87	179681173.6	5.56541×10^{-9}
130	27560000	0.13	27559999.87	170055396.4	5.88044×10^{-9}
140	24710000	0.13	24709999.87	152469841.9	6.55867×10^{-9}
150	19540000	0.13	19539999.87	120569029	8.29400×10^{-9}
160	11261000	0.13	11260999.87	69484535.77	1.43917×10^{-8}
170	5840000	0.13	5839999.87	36034960	2.77508×10^{-8}
180	2115000	0.13	2114999.87	13050331.75	7.66264×10^{-8}
190	1474000	0.13	1473999.87	9095124.578	1.09949×10^{-7}
200	1048200	0.13	1048199.87	6467781.032	1.54613×10^{-7}
210	769000	0.14	768999.86	4745013.666	2.10748×10^{-7}
220	546000	0.14	545999.86	3369021.156	2.96822×10^{-7}
230	394000	0.14	393999.86	2431124.916	4.11332×10^{-7}
240	271000	0.14	270999.86	1672169.406	5.98026×10^{-7}
250	168660	0.14	168659.86	1040693.74	9.60897×10^{-7}
260	159730	0.14	15929.86	985592.3362	1.01462×10^{-6}
270	143220	0.14	143219.86	883719.5275	1.13158×10^{-6}
280	112910	0.14	112909.86	696695.6128	1.43535×10^{-6}
290	110220	0.14	110219.86	680097.3175	1.47038×10^{-6}
300	109310	0.14	10939.86	674482.2808	1.48262×10^{-6}
310	106225	0.14	106224.86	655446.6894	1.52568×10^{-6}
320	105990	0.14	105989.86	653996.6524	1.52906×10^{-6}
330	102810	0.14	102809.86	634374.8458	1.57635×10^{-6}
340	98720	0.14	98719.86	609138.0625	1.64166×10^{-6}
350	92890	0.14	92889.86	573164.8054	1.74470×10^{-6}
360	91320	0.14	91319.86	563477.3245	1.77469×10^{-6}
370	87170	0.14	87169.86	537870.289	1.85918×10^{-6}
380	86920	0.14	86919.86	536327.6965	1.86453×10^{-6}
390	86110	0.14	86109.86	531329.6968	1.88207×10^{-6}
400	86090	0.14	86089.86	531206.2894	1.88251×10^{-6}

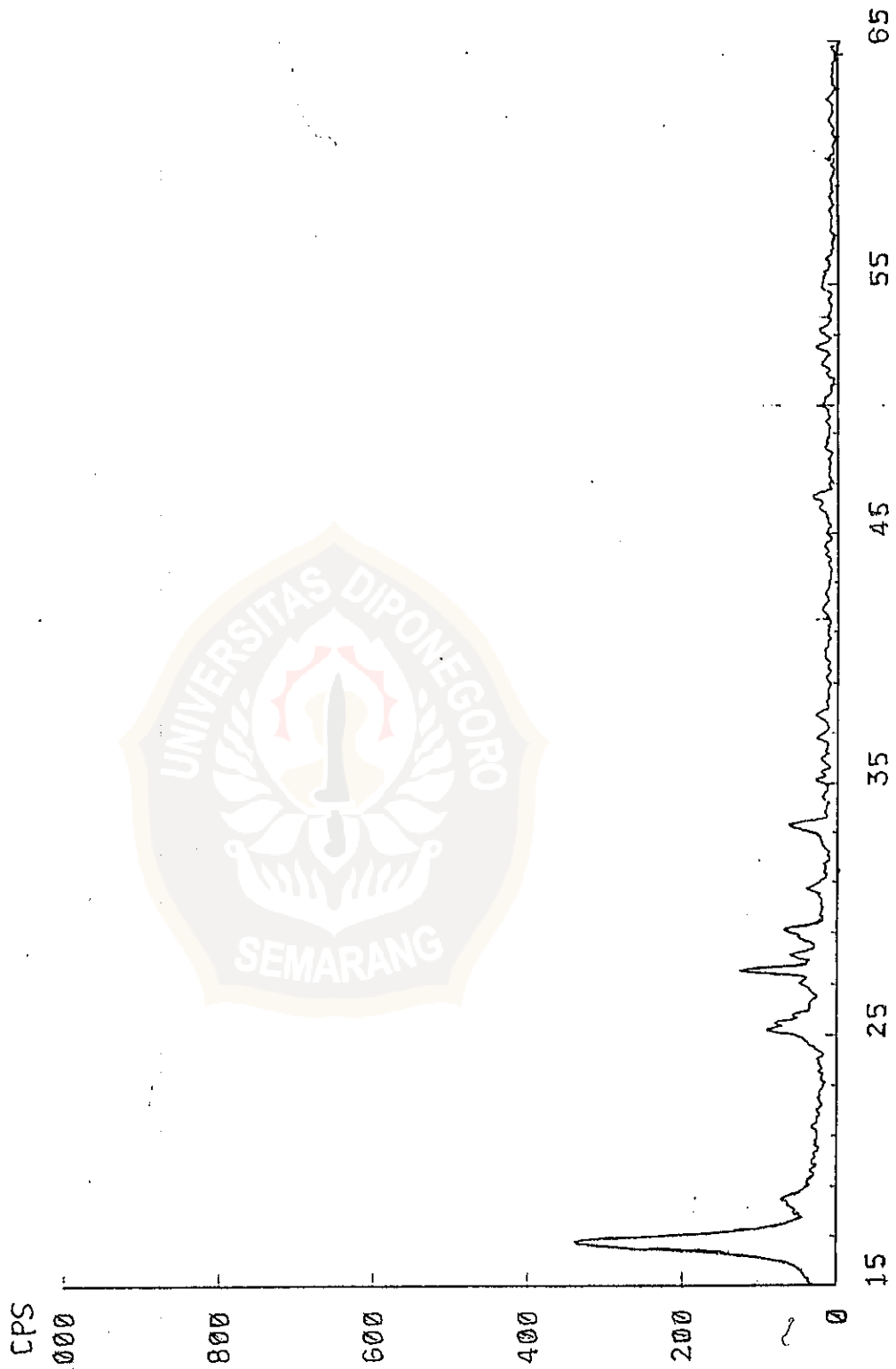
LAMPIRAN E

CHART NO :
VOLTAGE/CURRENT: 40 KV/ 20 MA
SCAN SPEED : 4.000 DEG./MIN.
SMOOTHING : 19
WAVE LENGTH : 1.5406 A
SAMPLING WIDTH : 0.020 DEG.
DATE : 00-00-2000
PRESET TIME : 0.00 SEC.
FILE NAME : BERF100
SAMPLE : 7HR-800-20



Gambar 4.3. Difraktogram sampel dengan sinter 1073 K.

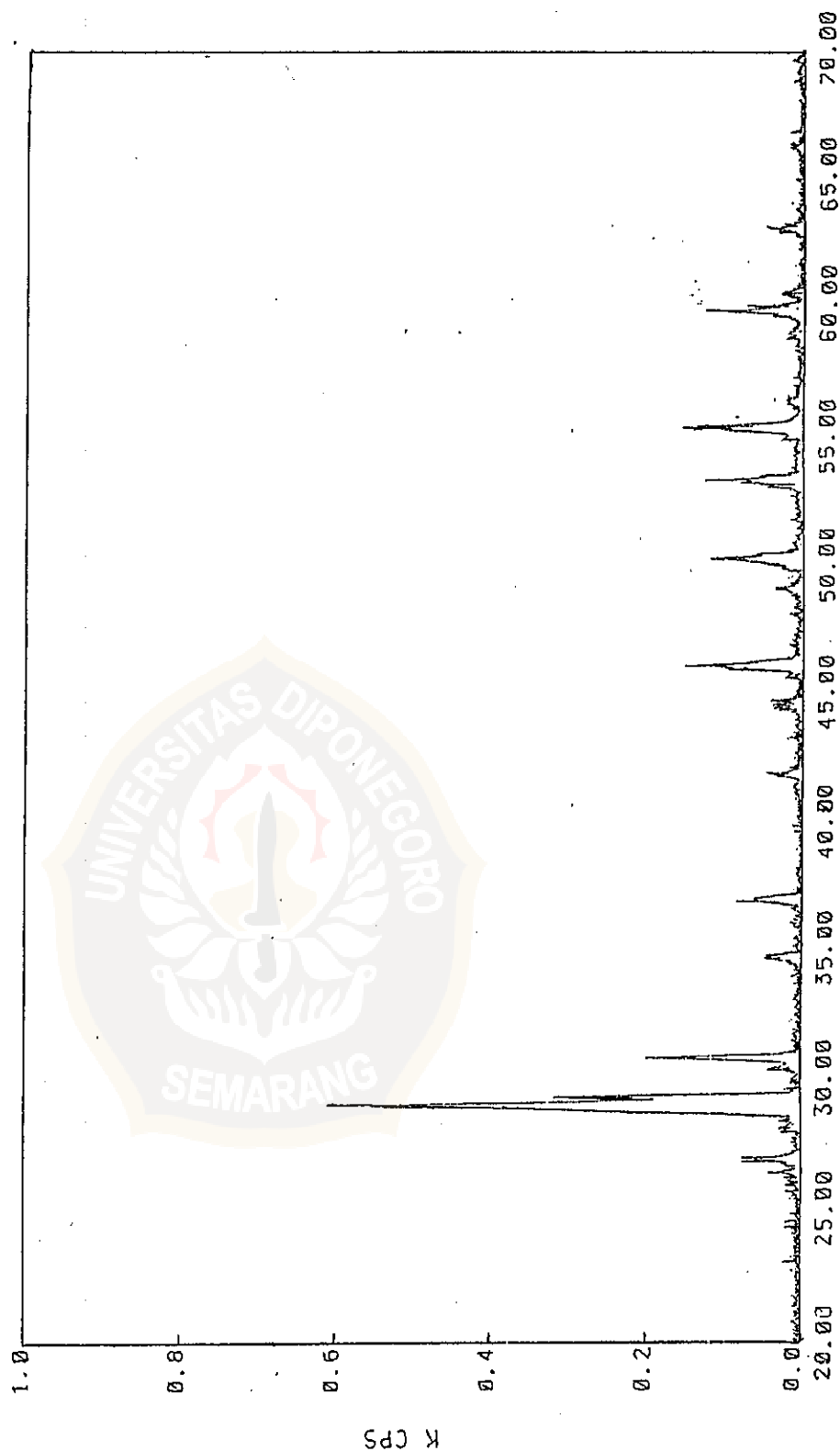
CHART NO :
VOLTAGE/CURRENT: 40 KV/ 20 MA
SCAN SPEED : 4.000 DEG./MIN.
SMOOTHING : 19
WAVE LENGTH : 1.5406 Å
SAMPLING WIDTH : 0.020 DEG.
DATE : 00-00-2000
PRESET TIME : 0.00 SEC.
FILE NAME : 9ERF100
SAMPLE : 7HR-825-20



Gambar 4.4. Difraktogram sampel dengan sinter 1098 K

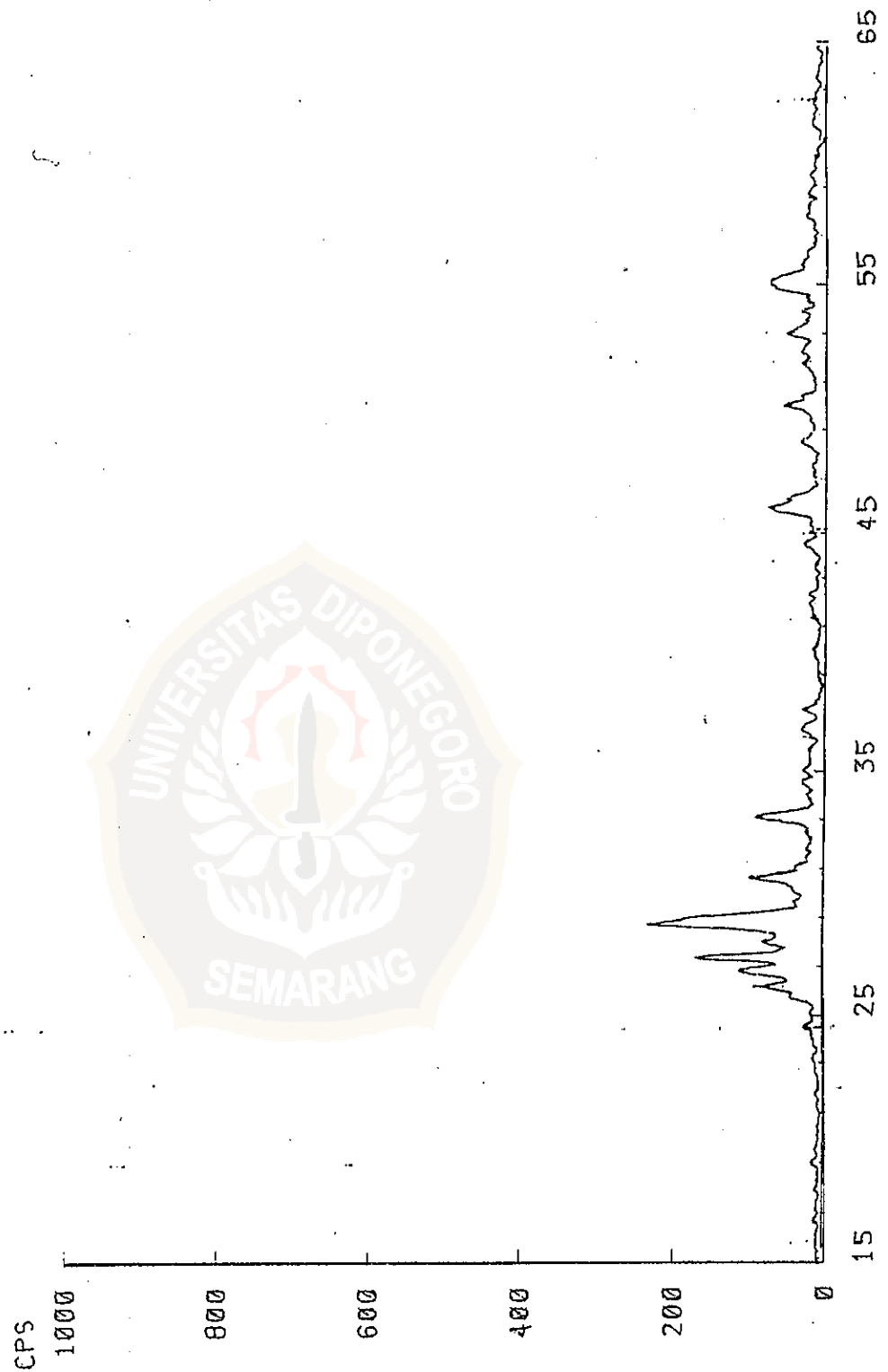
FILE NAME : EYF3100
 SAMPLE NAME : 20%-850DER
 GONTO : wideangle
 REPEAT : 1
 START : 20.000 [deg]
 SCAN SPEED : 4.00 [d/micr]
 SAMPLE TIME : 0.300 [sec]
 LAMBDA : 1.5406 [Å]
 SLIT1 : 1 00
 OPERATOR : INDR I
 MODE 1 : continuous
 AXIS : 2th/1th [th-S/1h-DJ]
 STOP : 70.000 [deg]
 SAMPLING : 0.020 [deg]
 FULL SOL : 1000. cps
 KV : 40.0
 SLIT2 : 0.15
 mA : 20.0
 SLIT3 : 0.60

FILE NAME : EYF3100
 [INTENSITY DATA]
 NUMBER OF DATA = 2500
 DATE : 28.04.03



Gambar 4.5. Difraktogram sampel dengan sinter 1123 K

CHART NO :
VOLTAGE/CURRENT: 40 KV/ 20 MA SMOOTHING : 19
SCAN SPEED : 4.000 DEG./MIN. WAVE LENGTH : 1.5406 Å
SAMPLING WIDTH : 0.020 DEG.
PRESET TIME : 0.00 SEC.
FILE NAME : SERF100
SAMPLE : 7HR-875-20



Gambar 4.6. Difraktogram sampel dengan sinter 1148 K