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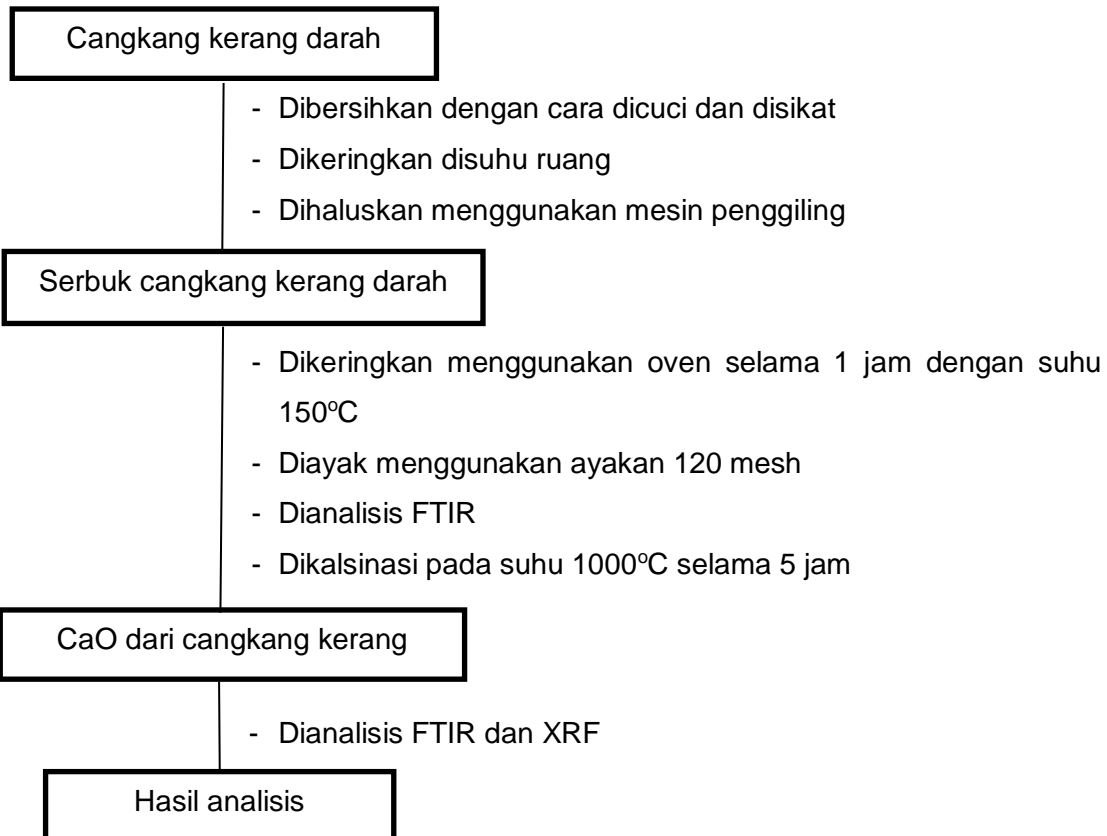


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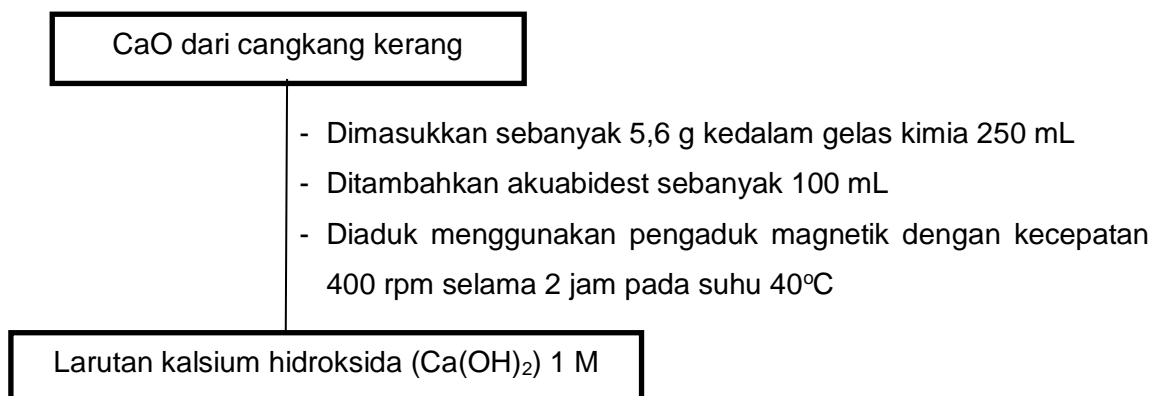
## LAMPIRAN 1. Bagan Kerja Penelitian

### 1. Preparasi Sampel

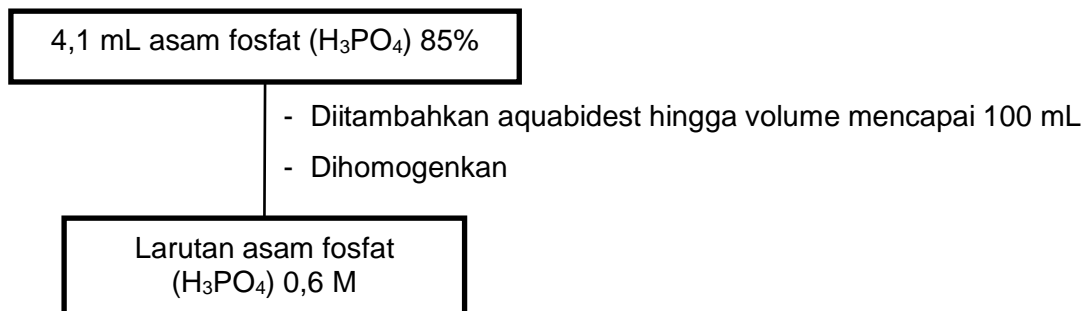


### 2. Pembuatan Larutan Kalsium Hidroksida dan Larutan Fosfat

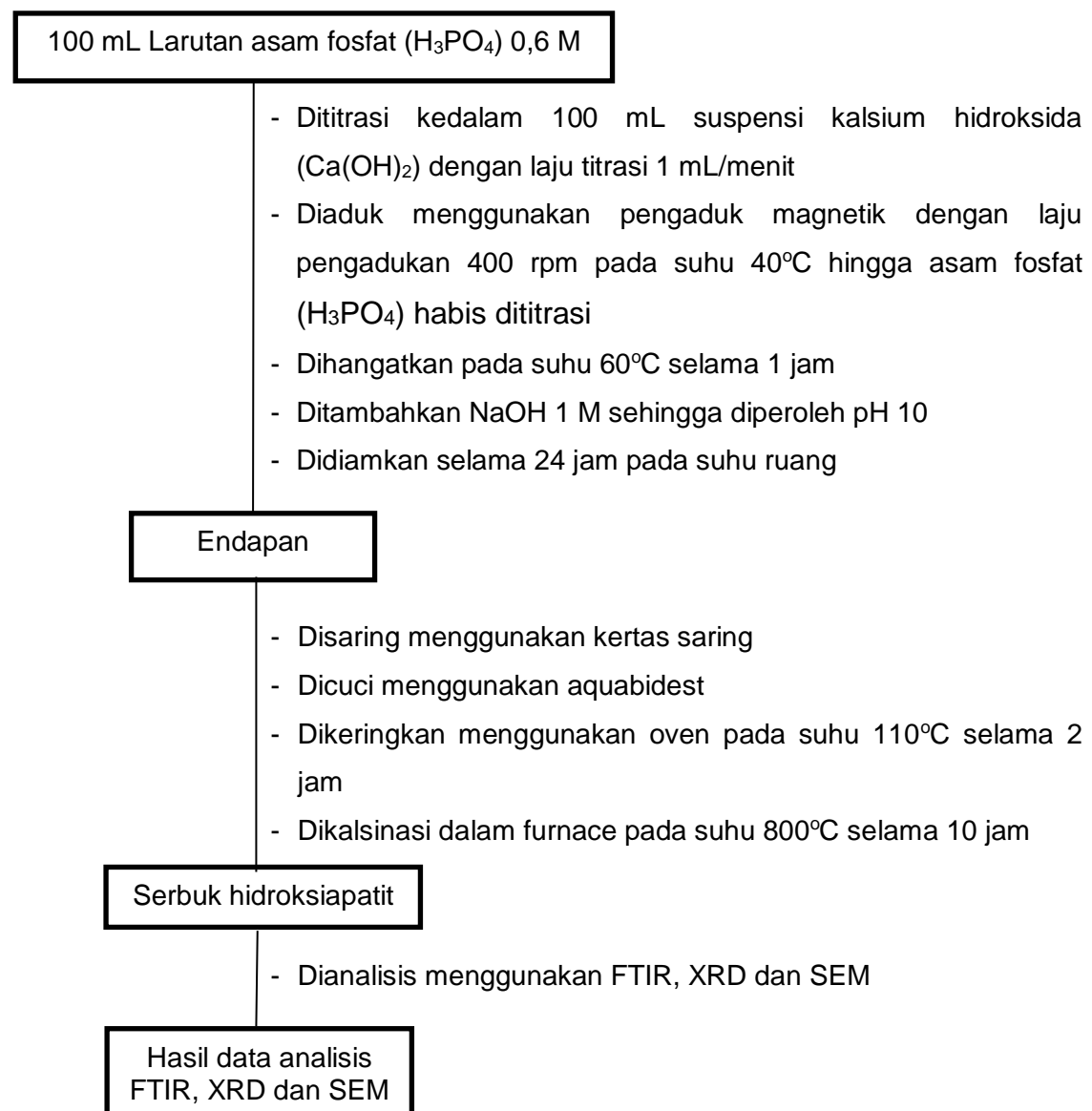
#### 2.1 Pembuatan Larutan Kalsium Hidroksida (Ca(OH)<sub>2</sub>) 1 M



## 2.2 Pembuatan Larutan Asam Fosfat ( $\text{H}_3\text{PO}_4$ ) 0,6 M

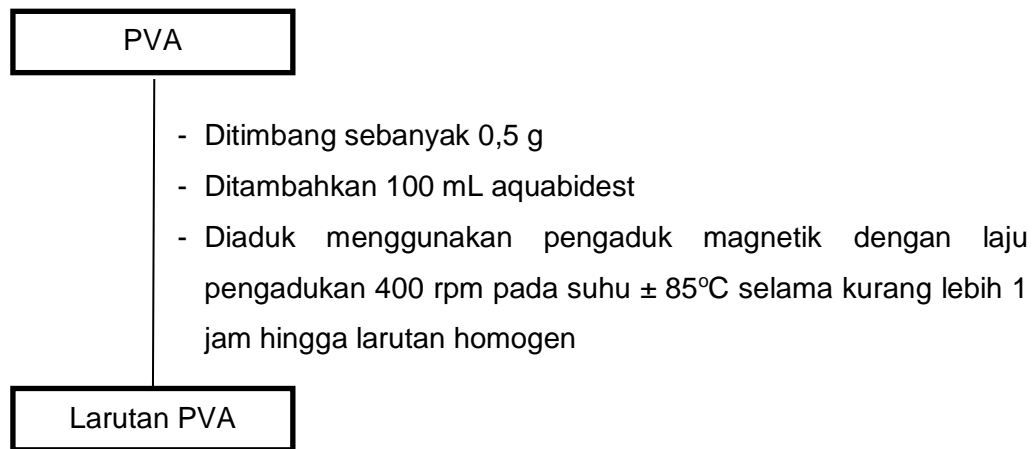


## 3. Sintesis Hidroksiapatit

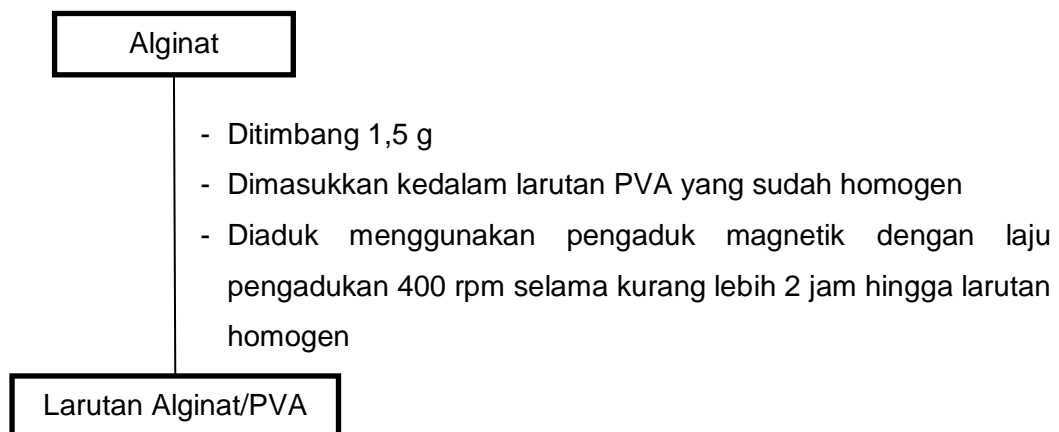


## 4. Sintesis Komposit Hidroksiapatit/Alginat/PVA

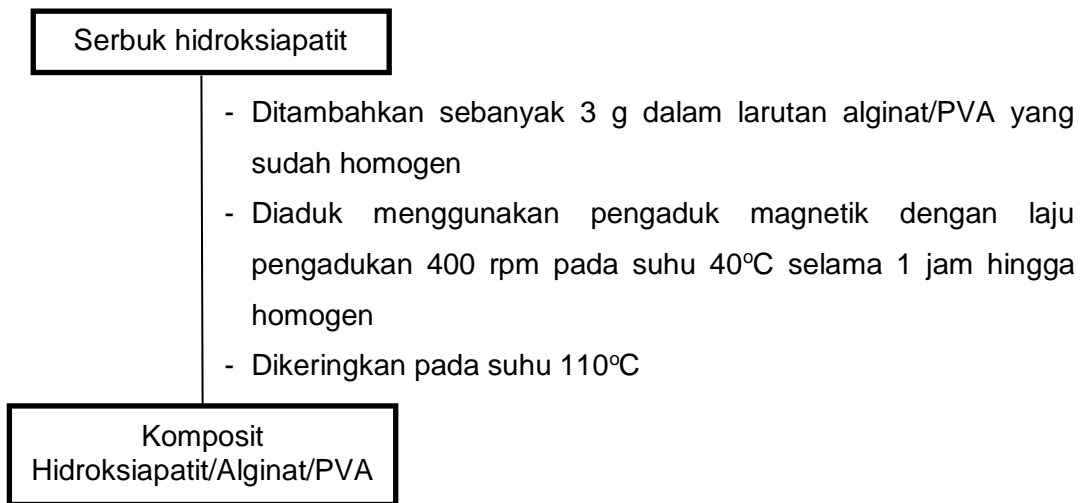
### 4.1 Pembuatan Larutan PVA



### 4.2 Pembuatan Larutan Komposit Alginat/PVA



### 4.3 Komposit Hidroksiapatit/Alginat/PVA



## 5. Pelapisan Implan Gigi dengan Metode *Dip Coating*

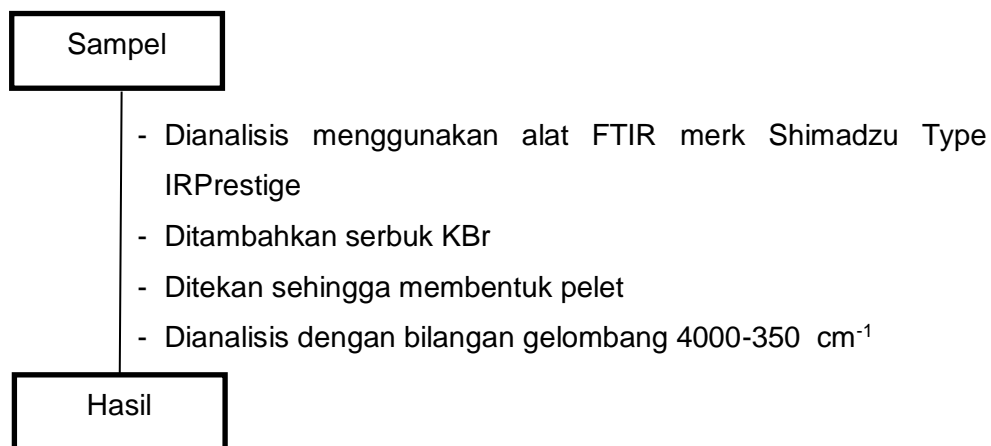
Logam Ti-6Al-4V

- Dipotong dengan ukuran panjang 1 cm, lebar 1 cm dan tebal 0,5 cm
- Dihaluskan menggunakan amplas
- Dicuci menggunakan etanol 70%
- Dibilas dengan aquabidest
- Ditimbang sebanyak 1 g PVA
- Dilarutkan dalam 20 mL aquabidest
- Diaduk menggunakan pengaduk magnetik dengan laju pengadukan 400 rpm pada suhu  $\pm 85^{\circ}\text{C}$  hingga larut
- Ditimbang sebanyak 5 g komposit hidroksiapatit/alginat/PVA
- Dimasukkan kedalam larutan PVA yang telah larut
- Diaduk menggunakan pengaduk magnetik dengan laju pengadukan 400 rpm pada suhu  $40^{\circ}\text{C}$  hingga homogen
- Dicelupkan logam Ti-6Al-4V kedalam larutan komposit hidroksiapatit/alginat/PVA yang telah homogen
- Diangkat logam Ti-6Al-4V yang telah terlapisi komposit hidroksiapatit/alginat/PVA
- Dikeringkan menggunakan oven pada suhu  $150^{\circ}\text{C}$  selama 1 jam
- Dianalisis menggunakan FTIR, XRD dan SEM, uji mekanik dan ketahanan korosi

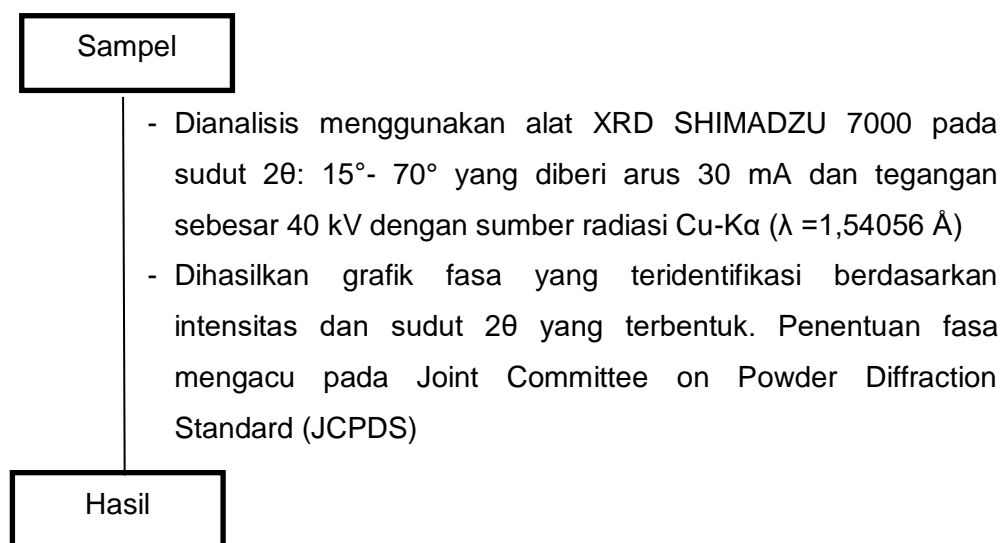
Hasil analisis FTIR, XRD, SEM, uji mekanik dan ketahanan korosi

## 6. Karakterisasi

### 6.1 Karakterisasi Hidroksiapatit, Hidroksiapatit/Alginat, Pelapis Implan Gigi Hidroksiapatit/Alginat/PVA dengan FTIR

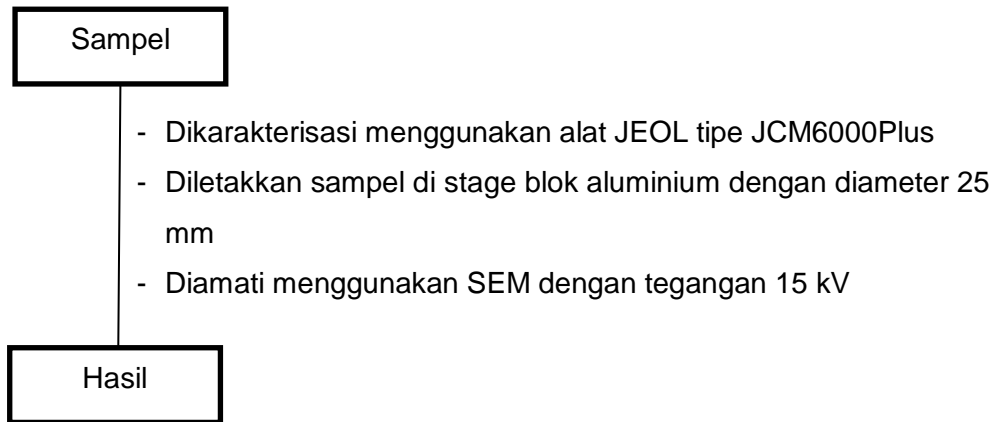


### 6.2 Karakterisasi Hidroksiapatit dan Pelapis Implan Gigi Hidroksiapatit/Alginat/PVA dengan XRD

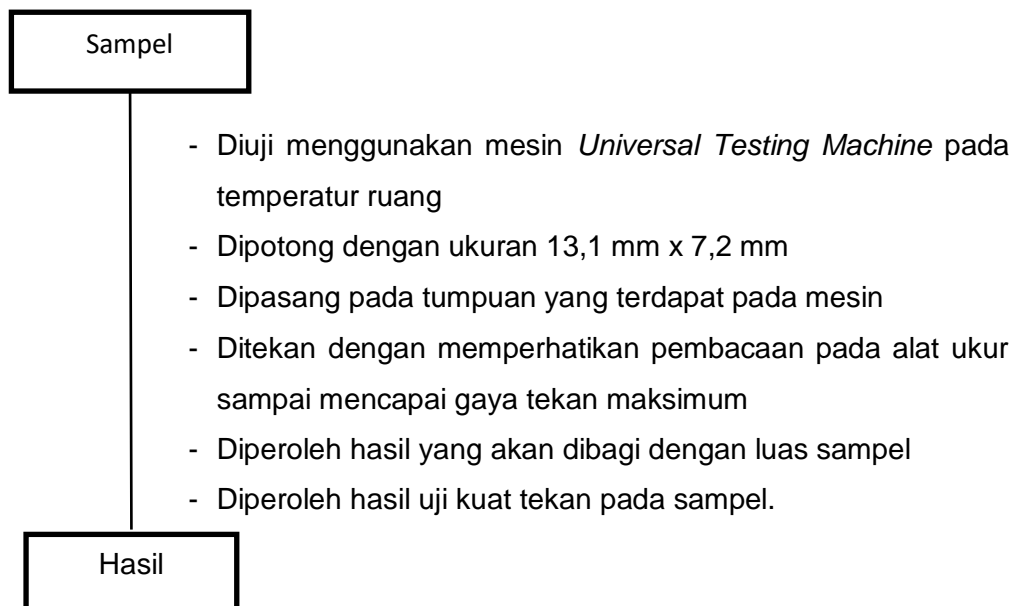




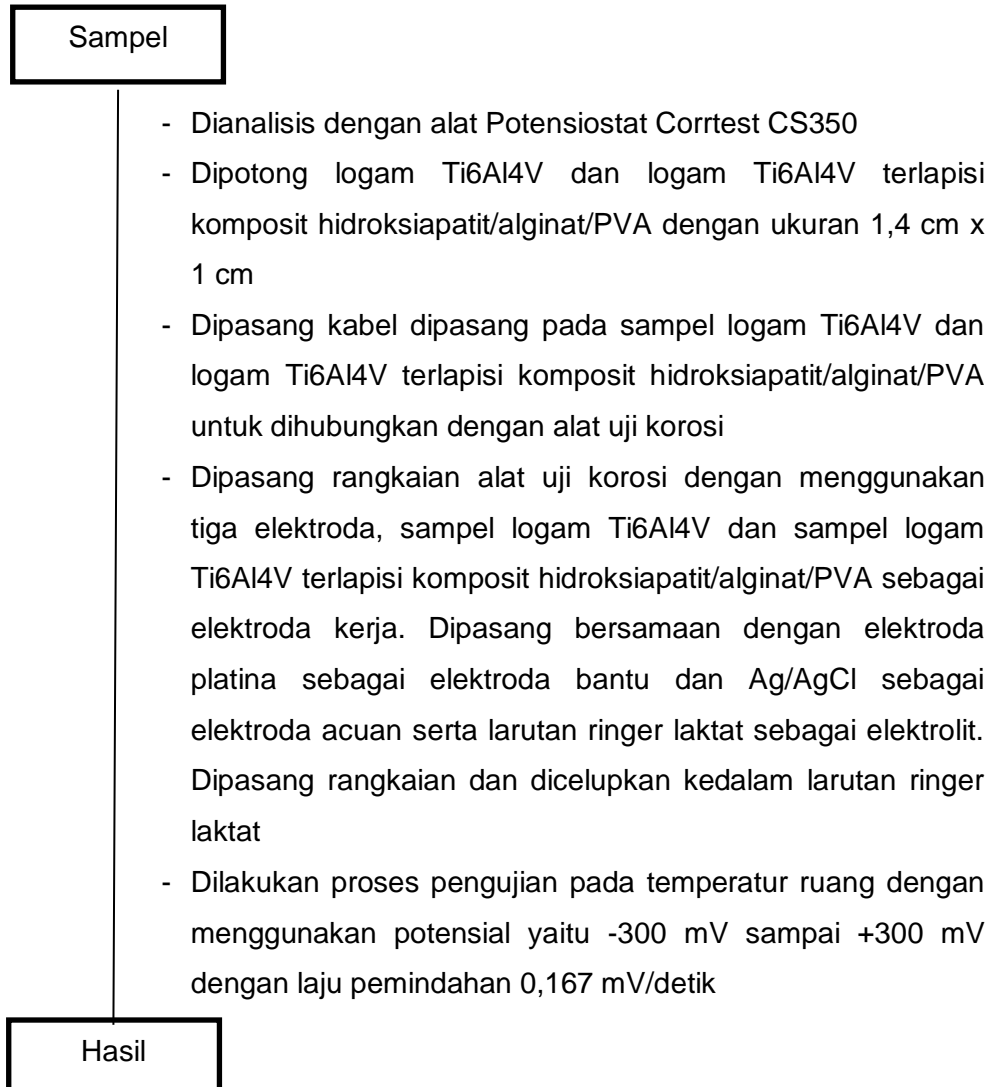
### 6.3. Karakterisasi Hidroksiapatit dan Pelapis Implan Gigi Hidroksiapatit/Alginat/PVA dengan SEM



### 6.4 Uji Mekanik Pelapis Implan Gigi Hidroksiapatit/Alginat/PVA dengan Universal Testing Machine



## 6.5 Uji Ketahanan Korosi Pelapis Implan Gigi Hidroksiapatit/Alginat/PVA dengan *Potensiostat Corrtest CS350*



## LAMPIRAN 2. Data Analisa dan Hasil Analisa

### Data Analisa

#### 1. Pembuatan larutan kalsium hidroksida ( $\text{Ca(OH)}_2$ ) 1 M dalam 100 mL

$$M = \frac{\text{g CaO}}{\text{Mr CaO}} \times \frac{1000}{V}$$

$$\text{g CaO} = \frac{M \times \text{Mr CaO} \times V}{1000}$$

$$\text{g CaO} = \frac{1 \text{ mol/L} \times 56 \text{ g/mol} \times 100 \text{ mL}}{1000 \text{ mL/L}}$$

$$\text{CaO} = 5,6 \text{ g}$$

#### 2. Pembuatan larutan asam fosfat ( $\text{H}_3\text{PO}_4$ ) 0,6 M dalam 100 mL

$$\begin{aligned} M &= \frac{\% \times \text{BJ} \times 1000}{\text{Mr}} \\ &= \frac{85\% \times 1,6845 \text{ g/mL} \times 1000 \text{ mL/L}}{98 \text{ g/mol}} \\ &= \frac{0,85 \times 1,6845 \text{ g/mL} \times 1000 \text{ mL/L}}{98 \text{ g/mol}} \\ &= 14,6 \text{ mol/L} \\ &= 14,6 \text{ M} \end{aligned}$$

Jadi volume yang dibutuhkan untuk pembuatan larutan asam fosfat 0,6 M dalam 100 mL yaitu sebagai berikut:

$$\begin{aligned} V_1 \times M_1 &= V_2 \times M_2 \\ V_1 \times 14,6 \text{ M} &= 100 \text{ mL} \times 0,6 \text{ M} \\ V_1 &= \frac{100 \text{ mL} \times 0,6 \text{ M}}{14,6 \text{ M}} \\ &= 4,1 \text{ mL} \end{aligned}$$

### 3. Pembuatan larutan NaOH 1 M dalam 100 mL

$$M = \frac{g \text{ NaOH}}{Mr \text{ NaOH}} \times \frac{1000}{V}$$

$$g \text{ NaOH} = \frac{M \times Mr \text{ NaOH} \times V}{1000}$$

$$= \frac{1 \text{ mol/L} \times 40 \text{ g/mol} \times 100 \text{ mL}}{1000 \text{ mL/L}}$$

$$= 4 \text{ g}$$

### 4. Perhitungan laju korosi :

#### 4.1 Logam Ti6Al4V tanpa lapisan

$$i_{\text{corr}} = 0,1068 \mu\text{A} / \text{cm}^2$$

$$i_{\text{corr}} = 0,1068 \times 10^{-6} \text{ A} / \text{cm}^2$$

$$CR = \frac{I_{\text{corr}}}{\rho} EW$$

$$CR = \frac{0,1068 \times 10^{-6} \text{ A/cm}^2 \times 11.682 \text{ g/mol}}{4,51 \text{ g/cm}^3}$$

$$= 0,2766 \times 10^{-6} \text{ A.cm/mol}$$

CR dalam mm/y

$$CR \text{ (mm/y)} = \frac{0,2766 \times 10^{-6} \text{ A.cm/mol}}{96.485 \text{ C/mol}}$$

$$CR = \frac{0,2766 \times 10^{-6} \text{ A.cm/mol}}{96.485 \text{ A.detik/mol}}$$

$$= 2,866 \times 10^{-12} \text{ cm/detik}$$

$$= 2,866 \times 10^{-11} \text{ mm/detik}$$

$$CR \text{ (mm/y)} = 2,866 \times 10^{-11} \times \frac{\text{mm}}{\text{detik}} \times 3600 \frac{\text{detik}}{\text{jam}} \times 24 \frac{\text{jam}}{\text{hari}} \times 365 \frac{\text{hari}}{\text{tahun}}$$

$$= 0,000903 \text{ mm/y}$$

$$\begin{aligned} \text{CR (mpy)} &= \frac{0,000903 \text{ mm/y}}{0,0254 \text{ mm/mils}} \\ &= 0,0355 \text{ mpy} \end{aligned}$$

#### 4.2 Logam Ti6Al4V terlapis komposit hidroksiapatit/alginat/PVA

$$i_{\text{corr}} = 0,01807 \mu\text{A} / \text{cm}^2$$

$$i_{\text{corr}} = 0,01807 \times 10^{-6} \text{ A} / \text{cm}^2$$

$$\text{CR} = \frac{i_{\text{corr}}}{\rho} \text{ EW}$$

$$\begin{aligned} \text{CR} &= \frac{0,01807 \times 10^{-6} \text{ A/cm}^2 \times 11.682 \text{ g/mol}}{4,51 \text{ g/cm}^3} \\ &= 0,0468 \times 10^{-6} \text{ A.cm/mol} \end{aligned}$$

CR dalam mm/y

$$\text{CR (mm/y)} = \frac{0,0468 \times 10^{-6} \text{ A.cm/mol}}{96.485 \text{ C/mol}}$$

$$\begin{aligned} \text{CR} &= \frac{0,0468 \times 10^{-6} \text{ A.cm/mol}}{96.485 \text{ A.detik/mol}} \\ &= 4,85 \times 10^{-13} \text{ cm/detik} \\ &= 4,85 \times 10^{-12} \text{ mm/detik} \end{aligned}$$

$$\begin{aligned} \text{CR (mm/y)} &= 4,85 \times 10^{-12} \times \frac{\text{mm}}{\text{detik}} \times 3600 \frac{\text{detik}}{\text{jam}} \times 24 \frac{\text{jam}}{\text{hari}} \times 365 \frac{\text{hari}}{\text{tahun}} \\ &= 0,0001529 \text{ mm/y} \end{aligned}$$

$$\begin{aligned} \text{CR (mpy)} &= \frac{0,0001529 \text{ mm/y}}{0,0254 \text{ mm/mils}} \\ &= 0,00601 \text{ mpy} \end{aligned}$$

## Hasil Analisa

### 1. Karakterisasi cangkang kerang darah setelah kalsinasi dengan XRF



LABORATORIUM PENELITIAN DAN PENGEMBANGAN SAINS  
FAKULTAS MATEMATIKA DAN ILMU PENGETAHUAN ALAM  
UNIVERSITAS HASANUDDIN  
Jl. Perintis Kemerdekaan Km. 10 Tamalanrea, Makassar 90245  
Telp. 0411-586016 • Fax. 0411-588551 • Email : [lpps.fmipa.unhas@gmail.com](mailto:lpps.fmipa.unhas@gmail.com)

#### LAPORAN HASIL PENGUJIAN CERTIFICATE OF ANALYSIS

Nomor Pekerjaan : LPPS.XJ-2208-12/1

#### I. Pelanggan / Principal

1.1 Nama / Name : Andriani Usman  
1.2 Alamat / Address : Komp. Unhas Antang Komunikasi V blok i7/157  
1.3 Telepon / Phone : 088245738408  
1.4 Personil Penghubung / Contact Person : -  
1.5 Email / Email : andrianiiiiussmanrs@gmail.com

#### II. Contoh Uji / Sample

2.1 Kode Sampel / Sampel Code : -  
2.2 Kemasan / Packaging : Botol vial  
2.3 Nama Sampel / Sample Name : Cangkang Kerang Darah  
2.4 Keterangan Lain / Other Information : -  
2.5 Tanggal Sampling / Date of Sampling : -  
2.6 Diterima / Date of Received : 11 Agustus 2022  
2.7 Tanggal Uji / Date of Analysis : 18 Agustus 2022  
2.8 Jenis Uji / Type of Analysis : Unsur dan Oksida

#### III. Hasil Uji / Result

Parameter	Satuan	Hasil
Ca	m/m%	95.31
Fe	m/m%	4.23
Sr	m/m%	0.417
Nb	m/m%	0.0145
Mo	m/m%	0.0098
In	m/m%	0.0088
Sb	m/m%	0.0061
Sn	m/m%	0.006

Parameter	Satuan	Hasil
CaO	m/m%	95.81
Fe <sub>2</sub> O <sub>3</sub>	m/m%	3.84
SrO	m/m%	0.313
Nb <sub>2</sub> O <sub>5</sub>	m/m%	0.0131
MoO <sub>3</sub>	m/m%	0.0093
In <sub>2</sub> O <sub>3</sub>	m/m%	0.007

Makassar, 19 Agustus 2022  
Penanggung Jawab Mutu

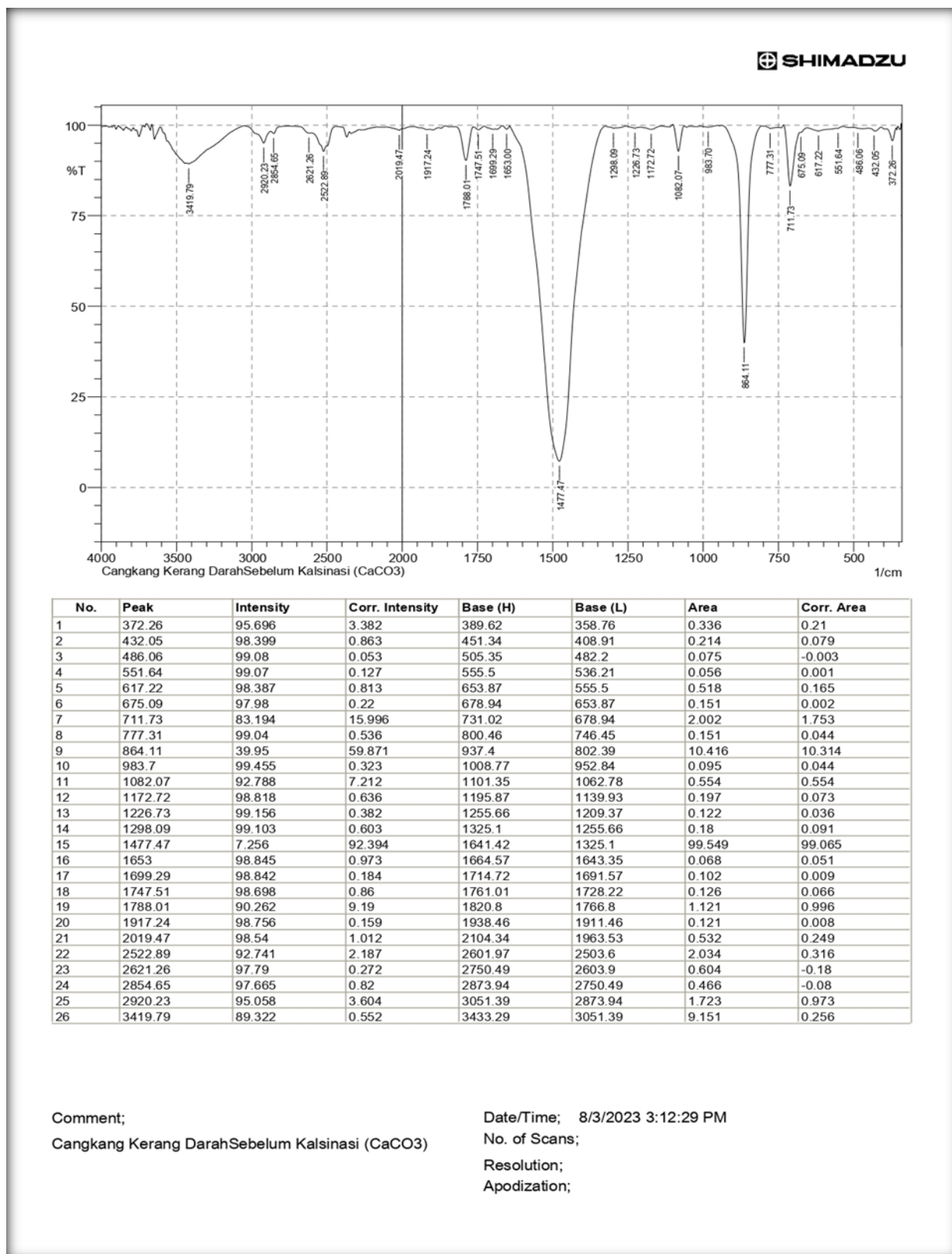
  
Prof. Dr. Nuhuk Hariani Soekamto, MS  
NIP. 19601215 198702 2 001

#### Catatan:

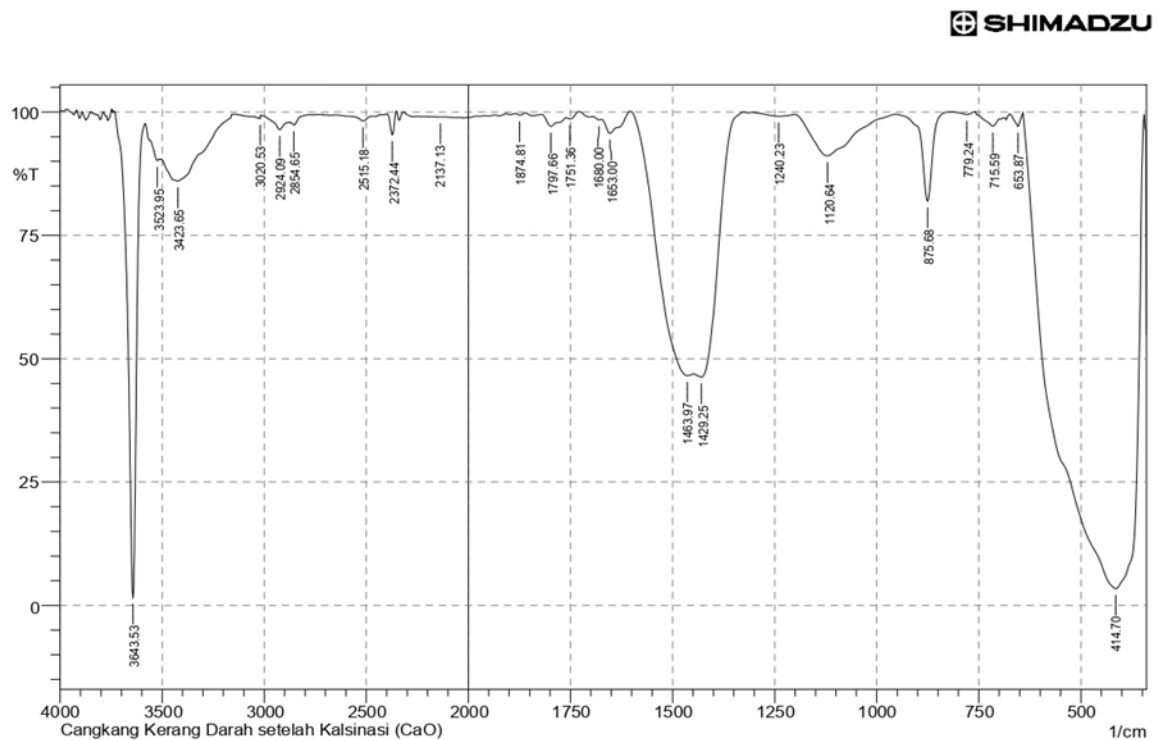
- Hasil Uji hanya berlaku untuk contoh tersebut di atas
- Dilarang mengutip/menyalin sebagian isi hasil uji ini

## 2. Karakterisasi dengan FTIR

### a. Cangkang kerang darah sebelum kalsinasi



## b. Cangkang kerang darah setelah kalsinasi



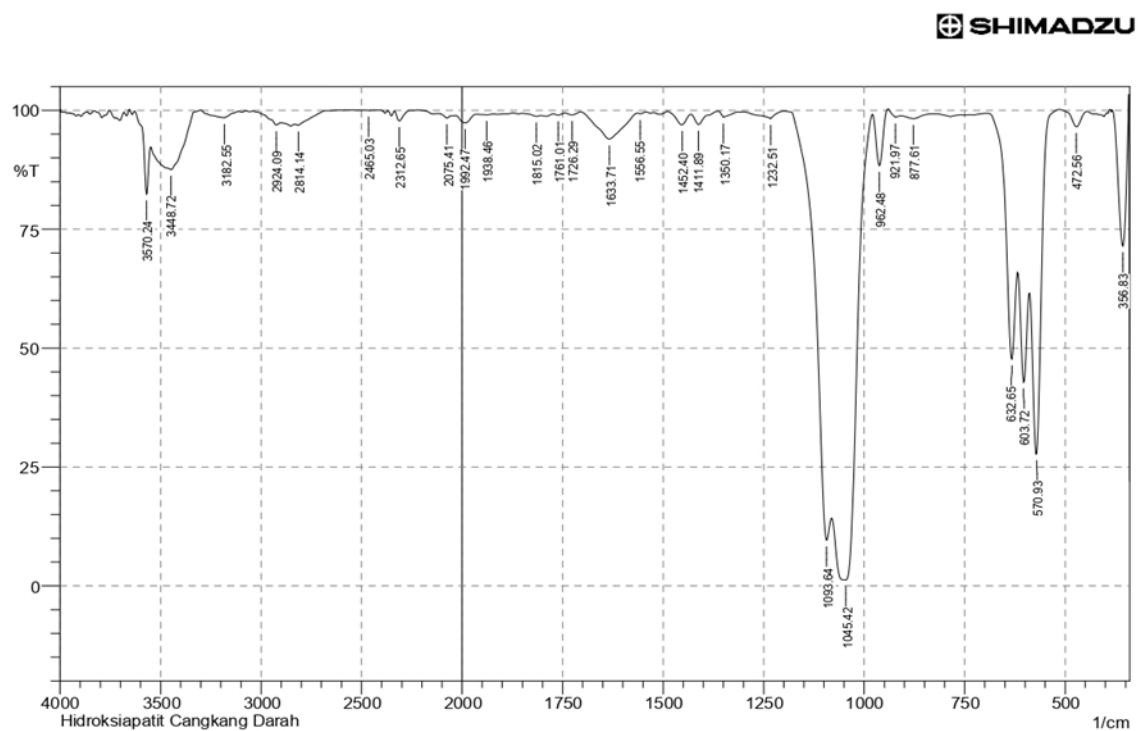
No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	414.7	3.431	94.972	642.3	347.19	211.034	209.606
2	653.87	97.095	2.65	675.09	642.3	0.217	0.176
3	715.59	97.135	1.913	758.02	698.23	0.454	0.287
4	779.24	99.497	0.601	815.89	758.02	0.048	0.07
5	875.68	81.951	17.892	952.84	817.82	2.519	2.408
6	1120.64	91.126	8.393	1199.72	954.76	4.705	4.204
7	1240.23	99.138	0.536	1303.88	1201.65	0.257	0.136
8	1429.25	46.262	8.323	1446.61	1327.03	18.575	2.275
9	1463.97	46.593	5.614	1602.85	1448.54	28.307	3.839
10	1653	95.69	3.307	1674.21	1602.85	0.785	0.576
11	1680	98.412	0.239	1697.36	1674.21	0.13	0.008
12	1751.36	98.611	0.561	1759.08	1730.15	0.111	0.044
13	1797.66	97.111	1.432	1820.8	1782.23	0.333	0.115
14	1874.81	99.376	0.363	1884.45	1859.38	0.048	0.021
15	2137.13	98.972	0.033	2254.79	2113.98	0.589	0.007
16	2372.44	95.387	4.568	2397.52	2353.16	0.431	0.415
17	2515.18	98.166	1.049	2655.98	2463.1	0.86	0.246
18	2854.65	97.398	0.852	2875.86	2779.42	0.598	0.039
19	2924.09	96.413	1.971	3016.67	2877.79	1.259	0.412
20	3020.53	98.67	0.669	3053.32	3018.6	0.166	0.049
21	3423.65	86.001	6.556	3510.45	3167.12	13.731	5.37
22	3523.95	90.18	1.464	3581.81	3512.37	2.243	0.33
23	3643.53	1.661	96.997	3736.12	3583.74	42.484	41.759

Comment;  
Cangkang Kerang Darah setelah Kalsinasi (CaO)

Date/Time; 8/3/2023 3:06:42 PM  
No. of Scans;  
Resolution;  
Apodization;



### c. Hidroksiapatit dari CaO cangkang kerang darah

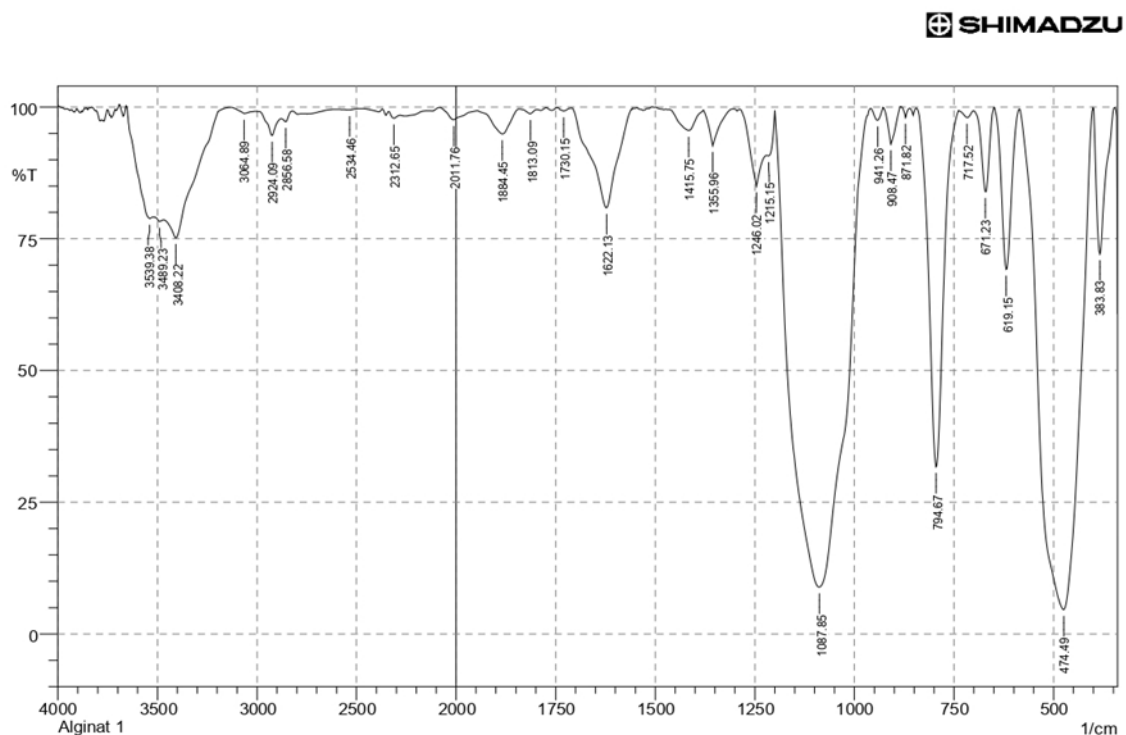


No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	356.83	71.463	26.912	381.91	343.33	3.011	2.785
2	472.56	96.555	3.384	514.99	445.56	0.386	0.381
3	570.93	27.714	43.244	588.29	516.92	12.287	6.547
4	603.72	42.841	20.733	617.22	590.22	7.705	2.359
5	632.65	47.696	24.222	694.37	619.15	8.391	2.775
6	877.61	98.263	0.761	908.47	827.46	0.439	0.112
7	921.97	98.537	0.923	941.26	908.47	0.125	0.066
8	962.48	88.388	11.29	979.84	941.26	0.975	0.931
9	1045.42	1.22	42.414	1080.14	979.84	83.178	44.339
10	1093.64	9.642	12.969	1199.72	1082.07	30.966	2.95
11	1232.51	98.271	1.507	1300.02	1199.72	0.384	0.275
12	1350.17	98.542	1.223	1363.67	1315.45	0.172	0.118
13	1411.89	97.036	2.328	1431.18	1363.67	0.409	0.26
14	1452.4	96.978	2.441	1489.05	1431.18	0.42	0.295
15	1556.55	99.292	0.205	1562.34	1543.05	0.048	0.01
16	1633.71	93.967	5.58	1703.14	1564.27	2.011	1.736
17	1726.29	99.04	0.521	1743.65	1705.07	0.119	0.048
18	1761.01	99.013	0.303	1772.58	1743.65	0.102	0.019
19	1815.02	98.745	0.28	1851.66	1803.44	0.198	0.017
20	1641.42	99.069	0.085	1948.1	1921.1	0.102	0.005
21	1992.47	97.365	1.702	2032.97	1963.53	0.531	0.24
22	2075.41	98.416	0.616	2121.7	2050.33	0.349	0.069
23	2312.65	97.799	2.116	2337.72	2264.43	0.347	0.326
24	2465.03	100.004	0.018	2488.17	2438.02	-0.003	0.002
25	2814.14	96.862	0.517	2831.5	2671.41	1.087	0.088
26	2924.09	96.935	0.818	3041.74	2902.87	0.901	0.051
27	3182.55	98.444	1.454	3302.13	3113.11	0.759	0.702
28	3448.72	87.572	7.894	3549.02	3302.13	8.914	4.759
29	3570.24	82.397	11.761	3628.1	3550.95	2.546	1.146

Comment;  
Hidroksiapatit Cangkang Darah

Date/Time; 3/3/2023 11:49:30 AM  
No. of Scans;  
Resolution;  
Apodization;

## d. Alginat

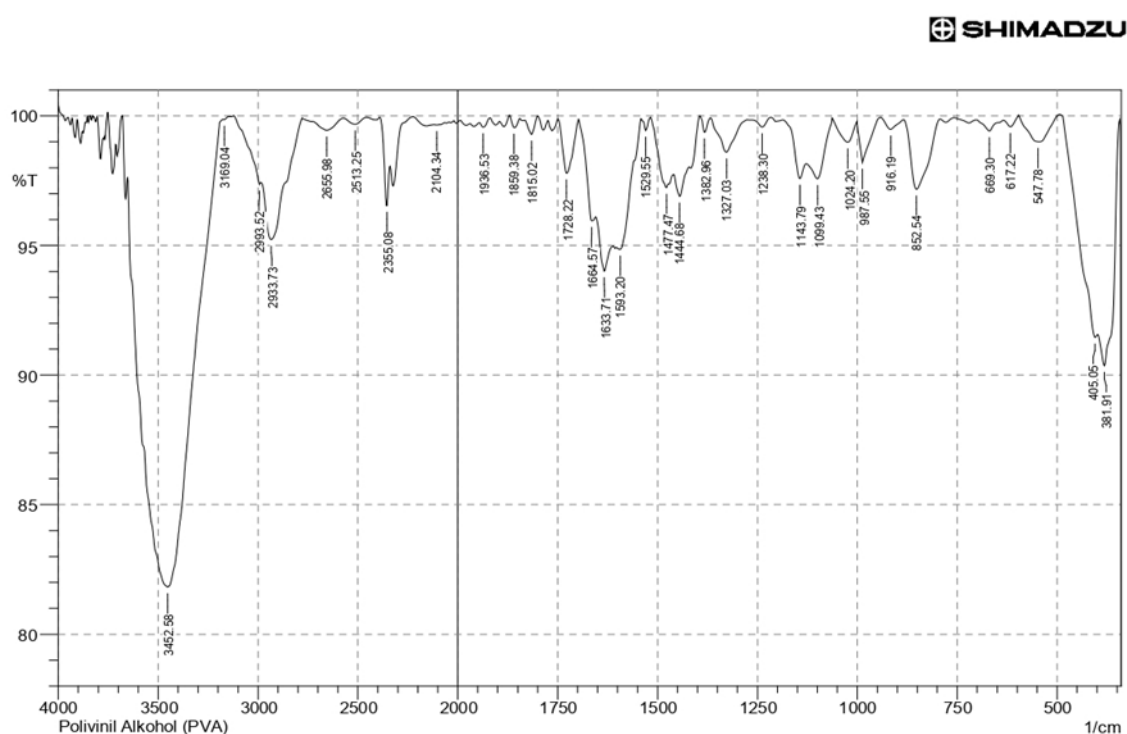


	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	383.83	72.117	27.465	399.26	347.19	3.414	3.343
2	474.49	4.628	95.127	584.43	401.19	100.219	100.001
3	619.15	69.186	30.535	648.08	586.36	4.189	4.112
4	671.23	83.941	15.711	700.16	650.01	1.626	1.543
5	717.52	98.006	1.3	738.74	700.16	0.223	0.107
6	794.67	31.779	67.76	842.89	738.74	16.837	16.619
7	871.82	98.02	1.894	883.4	862.18	0.068	0.061
8	908.47	93.003	6.998	927.76	883.4	0.608	0.61
9	941.26	97.492	2.357	958.62	927.76	0.202	0.18
10	1087.85	8.883	89.487	1197.79	960.55	113.64	112.045
11	1215.15	90.765	2.396	1220.94	1199.72	0.712	0.241
12	1246.02	85.013	9.15	1286.52	1220.94	2.582	1.113
13	1355.96	92.646	6.833	1379.1	1307.74	0.984	0.836
14	1415.75	95.561	3.906	1465.9	1379.1	0.966	0.769
15	1622.13	80.896	18.909	1708.93	1556.55	6.409	6.28
16	1730.15	99.262	0.249	1735.93	1710.86	0.055	0.013
17	1813.09	98.722	0.838	1843.95	1797.66	0.151	0.065
18	1884.45	94.905	4.574	1946.18	1843.95	1.199	0.954
19	2011.76	97.584	2.009	2083.12	1946.18	0.79	0.555
20	2312.65	97.873	0.961	2339.65	2279.86	0.442	0.128
21	2534.46	99.452	0.205	2603.9	2482.39	0.232	0.045
22	2856.58	97.224	1.08	2877.79	2818	0.488	0.1
23	2924.09	94.6	3.741	2987.74	2879.72	1.466	0.733
24	3064.89	98.773	0.774	3128.54	3007.02	0.403	0.172
25	3408.22	75.188	7.245	3468.01	3136.25	19.218	3.051
26	3489.23	78.299	0.523	3512.37	3469.94	4.442	0.059
27	3539.38	78.841	2.73	3657.04	3523.95	8.46	1.677

Comment;  
Alginat 1

Date/Time; 4/17/2023 11:06:51 AM  
No. of Scans;  
Resolution;  
Apodization;

## e. Polivinil alkohol (PVA)



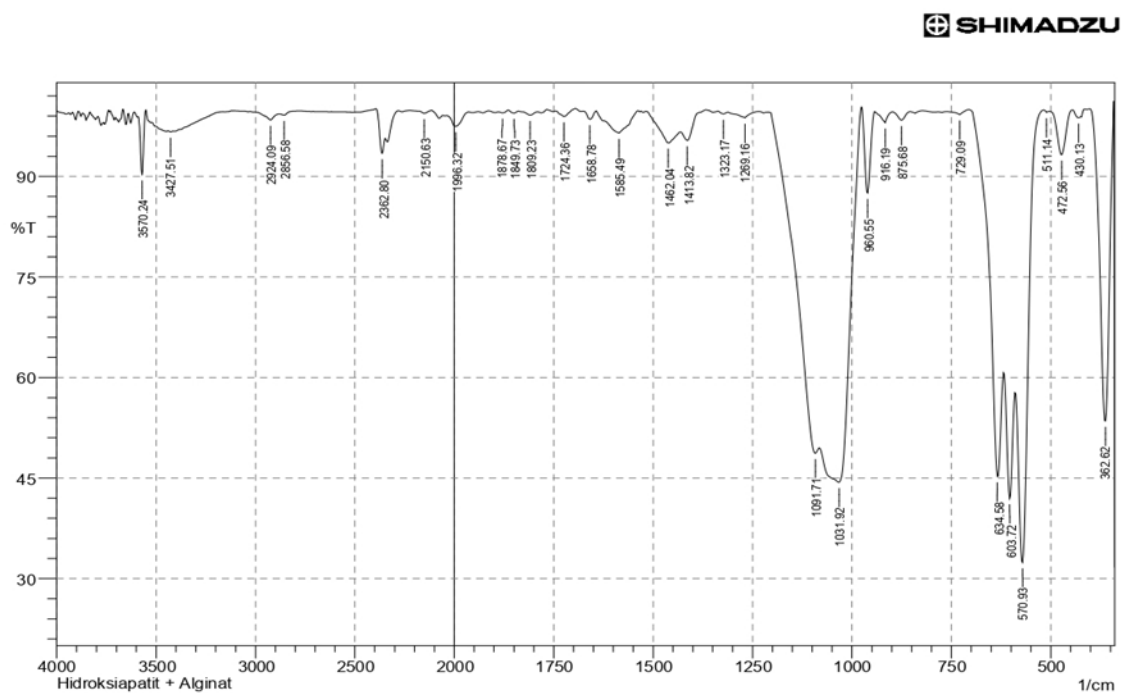
No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	381.91	90.36	3.564	397.34	343.33	1.714	0.701
2	405.05	91.457	0.673	486.06	399.26	1.889	0.192
3	547.78	99.008	0.039	596	545.85	0.134	0.028
4	617.22	99.58	0.339	634.58	596	0.042	0.03
5	669.3	99.417	0.422	704.02	634.58	0.099	0.051
6	852.54	97.169	2.694	885.33	792.74	0.625	0.572
7	916.19	99.485	0.418	941.26	885.33	0.078	0.053
8	987.55	98.201	1.617	1001.06	941.26	0.222	0.186
9	1024.2	98.982	0.852	1062.78	1001.06	0.175	0.135
10	1099.43	97.575	1.36	1128.36	1062.78	0.479	0.203
11	1143.79	97.584	1.022	1186.22	1128.36	0.316	0.063
12	1238.3	99.571	0.329	1263.37	1217.08	0.051	0.03
13	1327.03	98.603	1.289	1367.53	1276.88	0.287	0.243
14	1382.96	99.375	0.595	1394.53	1367.53	0.036	0.032
15	1444.68	96.898	0.958	1460.11	1421.54	0.436	0.078
16	1477.47	97.238	0.36	1517.98	1473.62	0.317	0.056
17	1529.55	99.433	0.483	1541.12	1517.98	0.028	0.02
18	1593.2	94.854	0.851	1602.85	1541.12	0.864	0.151
19	1633.71	94.016	1.547	1654.92	1610.56	1.026	0.146
20	1664.57	95.949	0.233	1697.36	1662.64	0.299	-0.022
21	1728.22	97.789	2.086	1749.44	1697.36	0.283	0.254
22	1815.02	99.285	0.636	1832.38	1799.59	0.057	0.045
23	1859.38	99.546	0.429	1870.95	1843.95	0.031	0.027
24	1936.53	99.568	0.236	1946.18	1919.17	0.035	0.015
25	2104.34	99.653	0.014	2117.84	2090.84	0.04	0.001
26	2355.08	96.536	2.077	2391.73	2339.65	0.401	0.173
27	2513.25	99.677	0.253	2574.97	2457.31	0.102	0.066
28	2655.98	99.445	0.398	2725.42	2574.97	0.241	0.142
29	2933.73	95.231	2.804	2983.88	2779.42	2.514	1.328
30	2993.52	97.353	0.223	3120.82	2985.81	0.7	-0.061
31	3169.04	99.86	0.026	3174.83	3143.97	0.011	0.001
32	3452.58	81.824	16.738	3653.18	3176.76	24.568	21.938

Date/Time; 4/17/2023 11:19:02 AM

No. of Scans;

Resolution;

## f. Komposit hidroksiapatit/alginat

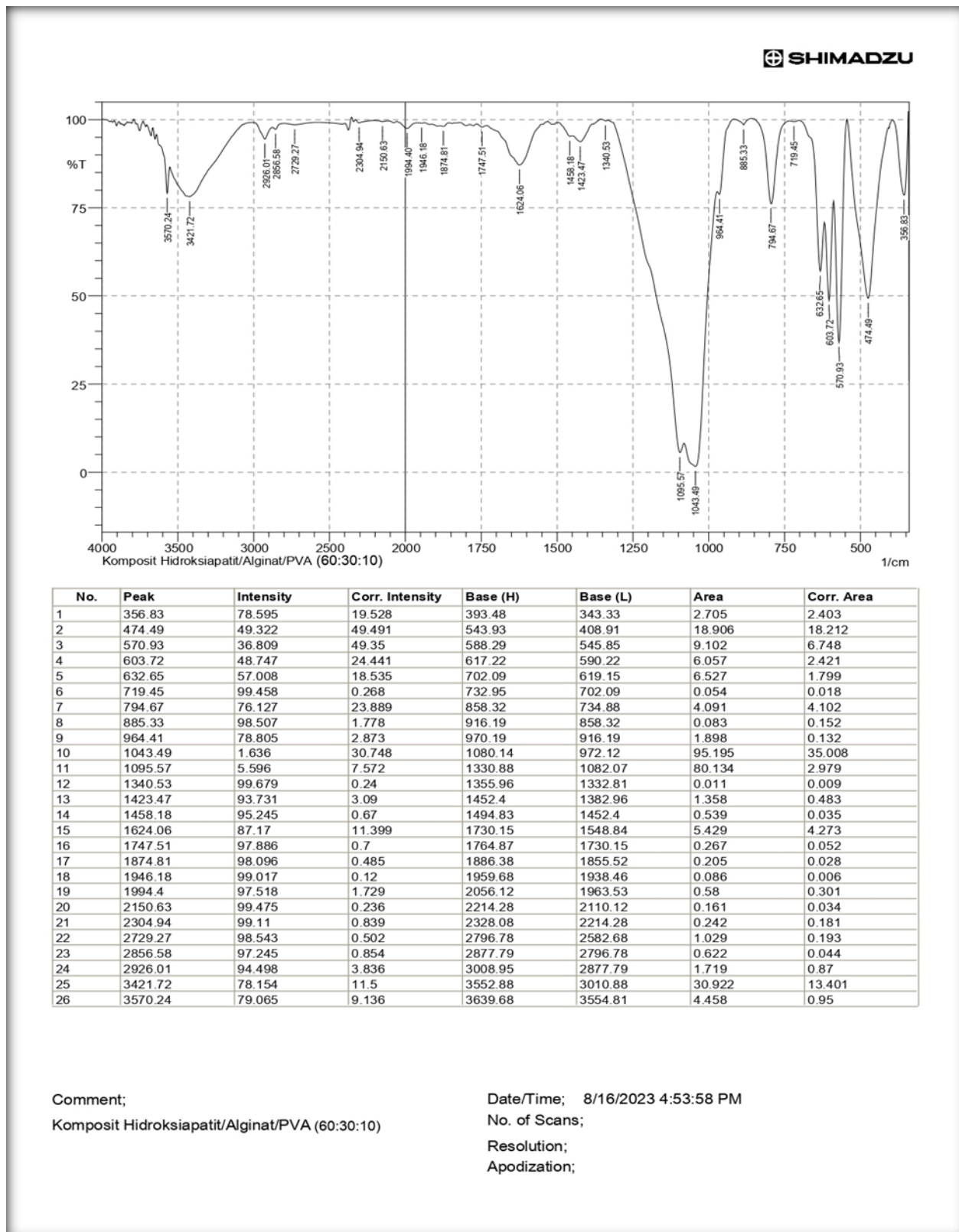


No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	362.62	53.517	45.098	401.19	343.33	6.639	6.37
2	430.13	98.762	0.438	443.63	424.34	0.077	0.027
3	472.56	93.239	6.567	505.35	447.49	0.74	0.687
4	511.14	99.581	0.203	518.85	505.35	0.016	0.004
5	570.93	32.428	35.699	588.29	518.85	12.799	5.84
6	603.72	41.979	17.129	617.22	590.22	8.214	2.025
7	634.58	45.242	22.434	705.95	619.15	11.133	2.939
8	729.09	99.228	0.617	761.88	705.95	0.099	0.056
9	875.68	98.408	1.245	898.83	854.47	0.177	0.11
10	916.19	98.032	1.614	943.19	898.83	0.193	0.126
11	960.55	87.513	12.492	975.98	943.19	0.903	0.901
12	1031.92	44.374	29.149	1082.07	975.98	26.158	10.352
13	1091.71	48.704	3.949	1203.58	1083.99	17.235	0.719
14	1269.16	98.754	0.882	1311.59	1234.44	0.244	0.12
15	1323.17	99.34	0.306	1336.67	1311.59	0.056	0.018
16	1413.82	95.366	2.167	1431.18	1367.53	0.63	0.146
17	1462.04	95.015	2.709	1517.98	1431.18	1.21	0.496
18	1585.49	96.484	2.496	1624.06	1537.27	0.872	0.515
19	1658.78	98.549	1.201	1676.14	1643.35	0.118	0.082
20	1724.36	98.955	0.962	1745.58	1695.43	0.114	0.102
21	1809.23	99.141	0.498	1826.59	1789.94	0.096	0.039
22	1849.73	99.454	0.339	1865.17	1840.09	0.042	0.021
23	1878.67	99.494	0.246	1888.31	1865.17	0.04	0.016
24	1996.32	97.482	1.911	2038.76	1963.53	0.496	0.286
25	2150.63	99.425	0.431	2222	2113.98	0.147	0.077
26	2362.8	93.461	3.705	2393.66	2347.37	0.764	0.333
27	2856.58	99.145	0.269	2879.72	2779.42	0.208	0.005
28	2924.09	98.429	0.996	3026.31	2879.72	0.532	0.213
29	3427.51	96.653	0.133	3441.01	3415.93	0.364	0.008
30	3570.24	90.266	9.167	3591.46	3550.95	0.823	0.718

Comment;  
Hidroksiapatit + Alginat

Date/Time; 3/30/2023 11:08:15 AM  
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Resolution;  
Apodization;

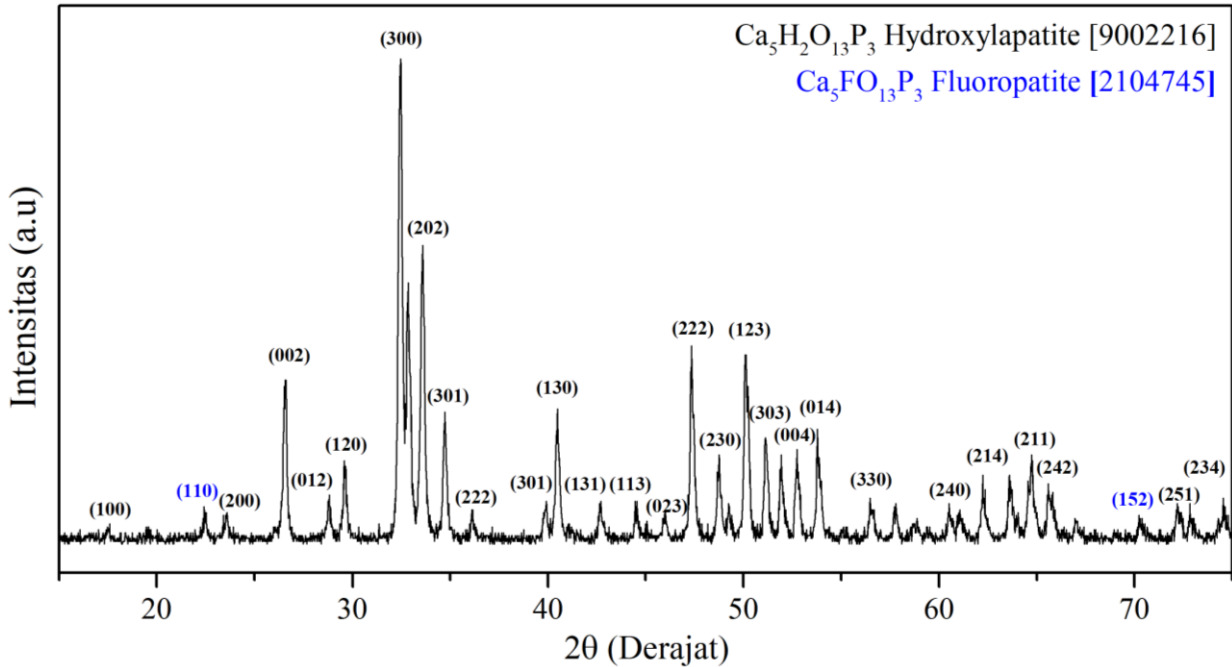
### g. Pelapis implan gigi hidroksiapatit/alginat/PVA



### 3. Karakterisasi dengan XRD

#### a. Hidroksiapatit dari CaO cangkang kerang darah

#### XRD Pattern



#### References

Formula sum	Ca <sub>5</sub> H <sub>2</sub> O <sub>13</sub> P <sub>3</sub>
Entry number	96-900-2217
Figure-of-Merit (FoM)	0.867074
Total number of peaks	134
Peaks in range	73
Peaks matched	63
Intensity scale factor	1.00
Space group	P 63/m
Crystal system	hexagonal
Unit cell	a= 9.4232 Å c= 6.8833 Å
I/Cor	1.59
Calc. density	3.157 g/cm <sup>3</sup>
Reference	Wilson R. M., Elliot J. C., Dowker S. E. P., "Rietveld refinement of the crystallographic structure of human dental enamel apatites Sample: Prep.63b, synthetic", American Mineralogist <b>84</b> , 1406-1414 (1999)
Formula sum	Ca <sub>4.852</sub> F <sub>0.89</sub> O <sub>12</sub> P <sub>3</sub> Sr <sub>0.148</sub>
Entry number	96-900-1389
Figure-of-Merit (FoM)	0.783678
Total number of peaks	133
Peaks in range	72
Peaks matched	59
Intensity scale factor	1.35
Space group	P 63/m
Crystal system	hexagonal
Unit cell	a= 9.3786 Å c= 6.8922 Å
I/Cor	1.77
Calc. density	3.221 g/cm <sup>3</sup>
Reference	Hughes J.M, Cameron M, Crowley K.D, "Ordering of divalent cations in the apatite structure: Crystal structure refinements of natural Mn- and Sr-bearing apatite sample Sr.29", American Mineralogist <b>76</b> , 1857-1862 (1991)

#### Percentage

Hydroxyapatite = ~98%

Fluorapatite = ~2%

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

Group : Standard  
Data : hidro#andriani

## # Strongest 3 peaks

no. peak	2Theta (deg)	d (A)	I/I1	FWHM (deg)	Intensity (Counts)	Integrated Int (Counts)	
1	8	32.4269	2.75879	100	0.20610	227	2521
2	10	33.5640	2.66788	59	0.21460	134	1607
3	9	32.8335	2.72555	48	0.22090	109	1425

## # Peak Data List

peak no.	2Theta (deg)	d (A)	I/I1	FWHM (deg)	Intensity (Counts)	Integrated Int (Counts)
1	22.4400	3.95885	5	0.18000	11	118
2	23.5250	3.77866	4	0.21000	10	115
3	26.5322	3.35681	34	0.18440	77	819
4	26.7800	3.32631	3	0.04000	7	32
5	28.7766	3.09990	7	0.19330	16	193
6	29.5866	3.01685	16	0.18670	36	397
7	32.1800	2.77939	6	0.05340	13	70
8	32.4269	2.75879	100	0.20610	227	2521
9	32.8335	2.72555	48	0.22090	109	1425
10	33.5640	2.66788	59	0.21460	134	1607
11	34.7100	2.58238	25	0.19500	57	637
12	36.1050	2.48573	6	0.15000	13	149
13	39.8483	2.26043	6	0.19670	14	137
14	40.4542	2.22796	26	0.19430	60	642
15	42.6500	2.11820	8	0.18000	18	205
16	44.4858	2.03496	7	0.16170	17	183
17	45.9600	1.97306	5	0.20000	11	123
18	47.3286	1.91914	43	0.18000	98	914
19	47.5600	1.91034	5	0.10000	12	140
20	48.7216	1.86748	18	0.17670	41	419
21	49.2393	1.84905	7	0.14530	15	140
22	50.1071	1.81904	44	0.19680	99	1138
23	51.1267	1.78513	23	0.18220	53	532
24	51.9092	1.76005	17	0.17350	39	378
25	52.1983	1.75098	4	0.09670	8	40
26	52.7123	1.73511	19	0.19130	43	472
27	53.7841	1.70303	23	0.17830	53	494
28	54.0200	1.69615	5	0.12000	11	110
29	56.5016	1.62740	9	0.18330	21	242
30	57.7450	1.59528	7	0.21000	17	196
31	58.6950	1.57170	4	0.11000	9	75
32	58.9300	1.56599	3	0.08000	7	41
33	60.5250	1.52849	6	0.17000	14	122
34	61.0300	1.51704	5	0.18000	11	121
35	62.2375	1.49048	12	0.20500	27	358
36	63.6000	1.46179	14	0.20000	31	345
37	64.0300	1.45301	4	0.14000	10	58
38	64.6000	1.44156	12	0.22000	28	232
39	64.7200	1.43917	14	0.23000	32	305
40	65.6050	1.42189	12	0.19000	28	281
41	65.8600	1.41700	4	0.16000	10	101
42	66.9900	1.39581	5	0.18000	12	147
43	70.2700	1.33848	4	0.18000	10	114
44	72.2083	1.30724	7	0.20330	16	182
45	72.8383	1.29748	5	0.14330	12	96
46	74.5616	1.27171	6	0.18330	13	185

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

```
# Data Infomation
  Group           : Standard
  Data            : hidro#andriani
  Sample Nmae    : serbuk
  Comment         :
  Date & Time     : 07-28-23 11:53:49

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

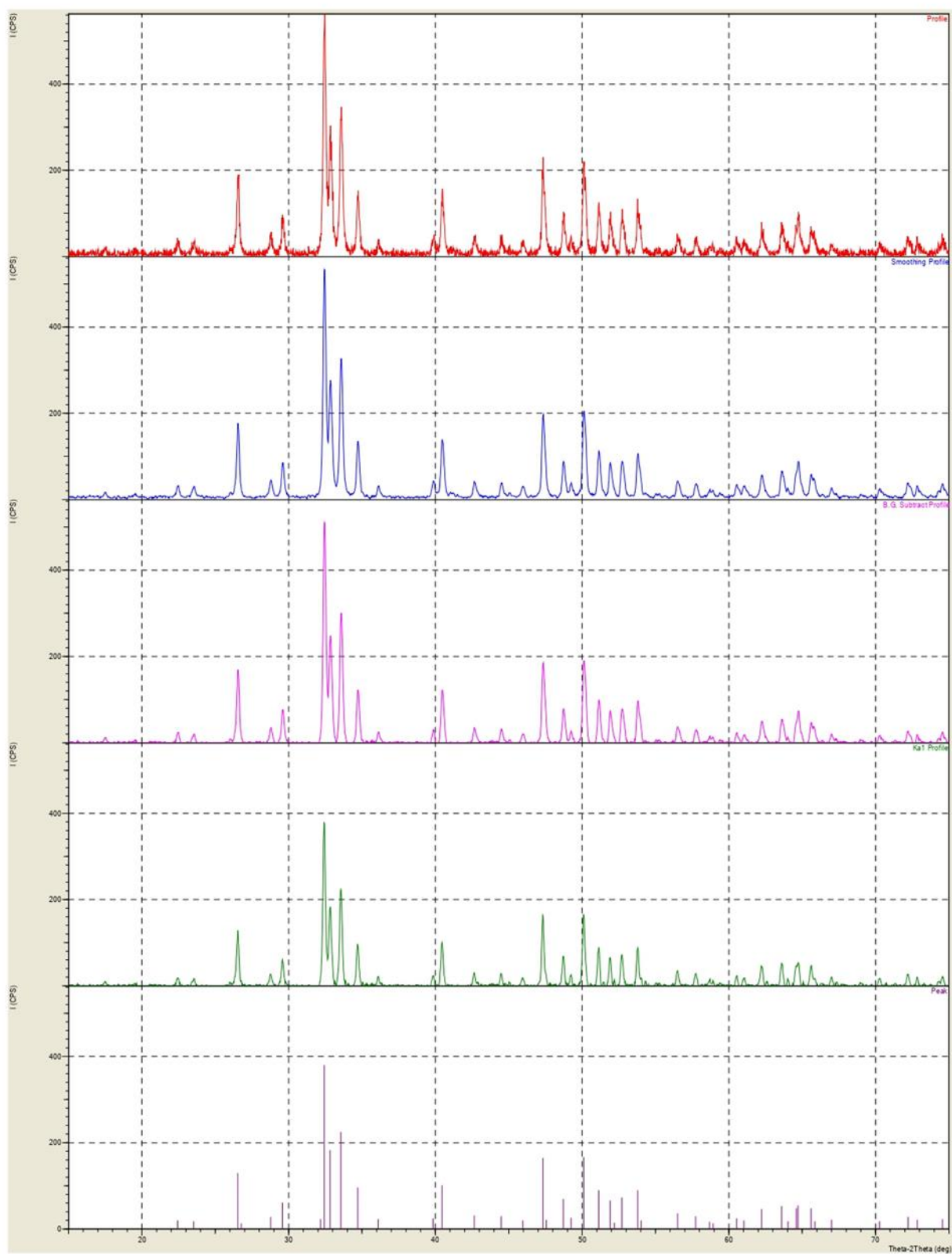
  Slits
    Auto Slit     : not Used
    divergence slit : 1.00000 (deg)
    scatter slit   : 1.00000 (deg)
    receiving slit : 0.30000 (mm)

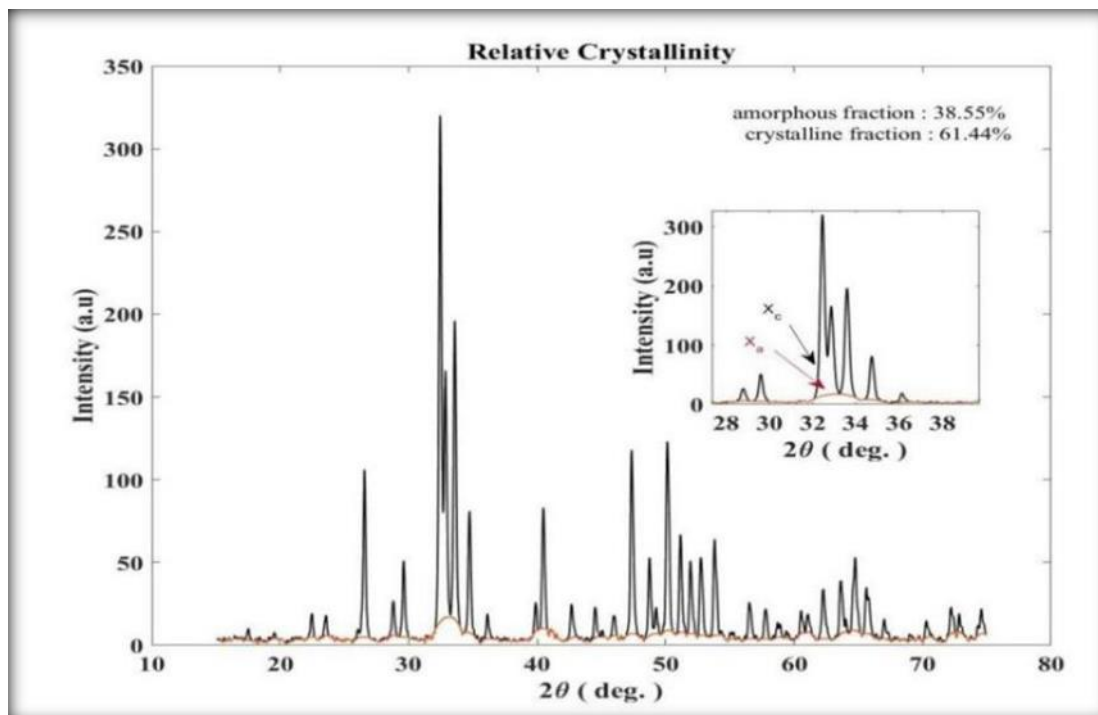
  Scanning
    drive axis    : Theta-2Theta
    scan range    : 15.0000 - 75.0000 (deg)
    scan mode     : Continuous Scan
    scan speed    : 2.0000 (deg/min)
    sampling pitch : 0.0200 (deg)
    preset time   : 0.60 (sec)

# Data Process Condition
  Smoothing [ AUTO ]
    smoothing points : 13
  B.G.Subtraction [ AUTO ]
    sampling points : 13
    repeat times    : 30
  Kal-a2 Separate [ MANUAL ]
    Kal a2 ratio    : 50 (%)
  Peak Search [ AUTO ]
    differential points : 11
    FWHM threhold    : 0.050 (deg)
    intensity threshold : 30 (par mil)
    FWHM ratio (n-1)/n : 2
  System error Correction [ NO ]
  Precise peak Correction [ NO ]
```



< Group: Standard Data: hidro#andriani >

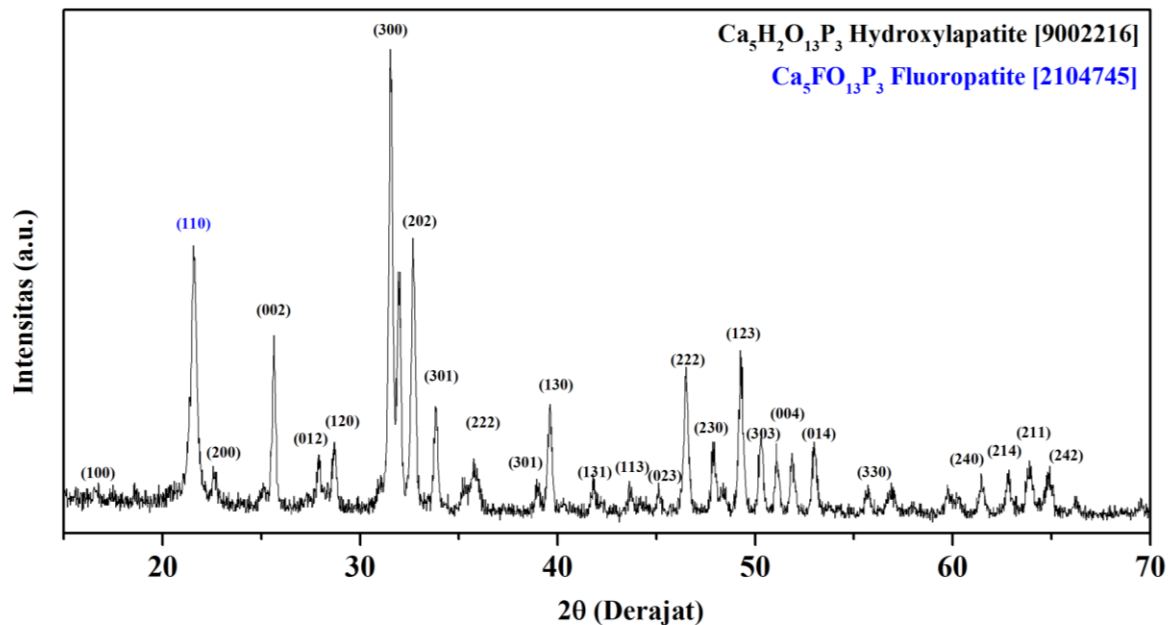




## b. Komposit hidroksiapatit/alginat/PVA

### XRD Pattern

Nama sampel: andriani#usman#161023



### References

Formula sum	Ca5 H2 O13 P3
Entry number	96-900-2217
Figure-of-Merit (FoM)	0.867074
Total number of peaks	134
Peaks in range	73
Peaks matched	63
Intensity scale factor	1.00
Space group	P 63/m
Crystal system	hexagonal
Unit cell	a= 9.4232 Å c= 6.8833 Å
I/σ	1.59
Calc. density	3.157 g/cm <sup>3</sup>
Reference	Wilson R. M., Elliot J. C., Dowker S. E. P., "Rietveld refinement of the crystallographic structure of human dental enamel apatites Sample: Prep.63b, synthetic", American Mineralogist <b>84</b> , 1406-1414 (1999)
Formula sum	Ca4.852 F0.89 O12 P3 Sr0.148
Entry number	96-900-1389
Figure-of-Merit (FoM)	0.783678
Total number of peaks	133
Peaks in range	72
Peaks matched	59
Intensity scale factor	1.35
Space group	P 63/m
Crystal system	hexagonal
Unit cell	a= 9.3786 Å c= 6.8922 Å
I/σ	1.77
Calc. density	3.221 g/cm <sup>3</sup>
Reference	Hughes J M, Cameron M, Crowley K D, "Ordering of divalent cations in the apatite structure: Crystal structure refinements of natural Mn- and Sr-bearing apatite sample Sr.29", American Mineralogist <b>76</b> , 1857-1862 (1991)

### Percentage

Hydroxyapatite = ~95%

Fluorapatite = ~5%

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

Group : Standard  
 Data : andriani#usman#161023

## # Strongest 3 peaks

no.	peak no.	2Theta (deg)	d (A)	I/I1	FWHM (deg)	Intensity (Counts)	Integrated Int (Counts)
1	12	31.5249	2.83564	100	0.21850	328	3863
2	14	32.6676	2.73901	56	0.23240	184	2372
3	3	21.5621	4.11801	52	0.30830	171	2408

## # Peak Data List

peak no.	2Theta (deg)	d (A)	I/I1	FWHM (deg)	Intensity (Counts)	Integrated Int (Counts)
1	21.0200	4.22297	3	0.08000	11	82
2	21.3000	4.16809	15	0.17340	50	526
3	21.5621	4.11801	52	0.30830	171	2408
4	21.9200	4.05157	5	0.16000	17	299
5	22.6150	3.92861	5	0.25000	18	262
6	25.0750	3.54849	4	0.23000	12	197
7	25.6147	3.47493	34	0.20770	110	1245
8	27.8866	3.19678	9	0.17330	31	350
9	28.3450	3.14611	3	0.11000	10	72
10	28.6630	3.11192	12	0.24600	39	473
11	30.9800	2.88426	4	0.28000	13	242
12	31.5249	2.83564	100	0.21850	328	3863
13	31.9378	2.79991	50	0.22310	163	2012
14	32.6676	2.73901	56	0.23240	184	2372
15	33.8056	2.64936	23	0.20690	74	852
16	35.2550	2.54369	5	0.33000	17	308
17	35.7400	2.51028	9	0.36000	31	390
18	35.9200	2.49811	7	0.28000	22	233
19	38.9633	2.30971	5	0.24670	16	208
20	39.5751	2.27540	23	0.22220	76	897
21	41.7914	2.15971	7	0.18290	23	336
22	43.6300	2.07287	5	0.18000	17	223
23	45.0883	2.00915	5	0.16330	18	169
24	46.4714	1.95253	35	0.19940	114	1279
25	46.7200	1.94271	3	0.12000	10	96
26	47.8619	1.89900	15	0.21890	50	601
27	48.2966	1.88291	5	0.20670	18	210
28	48.5200	1.87477	3	0.12000	10	78
29	48.9200	1.86037	3	0.13340	10	96
30	49.2446	1.84886	37	0.23070	122	1499
31	50.2671	1.81362	17	0.23150	57	716
32	51.0749	1.78682	14	0.18110	45	436
33	51.8454	1.76206	14	0.19360	46	517
34	52.9594	1.72759	16	0.23310	53	667
35	55.6600	1.65000	5	0.26000	18	245
36	56.7200	1.62165	3	0.24000	11	111
37	56.9000	1.61695	4	0.37340	14	188
38	59.7333	1.54684	5	0.18670	18	220
39	60.2853	1.53399	4	0.19730	14	190
40	61.4386	1.50793	9	0.21070	28	358
41	62.7791	1.47892	9	0.21170	30	367
42	63.8400	1.45687	9	0.32000	31	520
43	64.8200	1.43720	8	0.32000	26	429
44	66.1883	1.41076	3	0.19670	11	137

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

```
# Data Infomation
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  Data            : andriani#usman#161023
  Sample Nmae    : powder
  Comment         :
  Date & Time     : 10-17-23 14:57:20

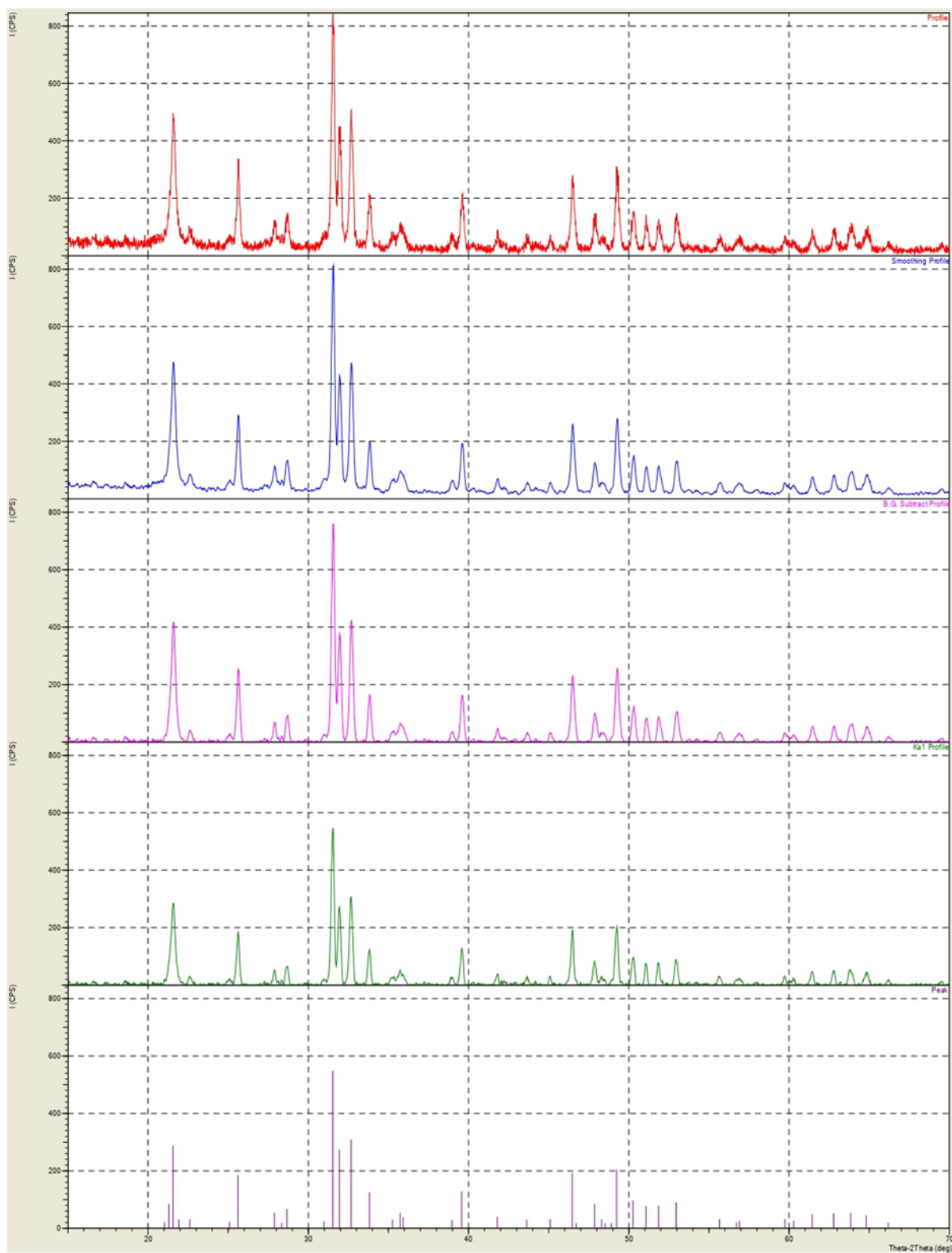
# Measurement Condition
  X-ray tube
  target          : Cu
  voltage         : 40.0 (kV)
  current         : 30.0 (mA)

  Slits
  Auto Slit      : not Used
  divergence slit : 1.00000 (deg)
  scatter slit   : 1.00000 (deg)
  receiving slit  : 0.30000 (mm)

  Scanning
  drive axis     : Theta-2Theta
  scan range     : 15.0000 - 70.0000 (deg)
  scan mode      : Continuous Scan
  scan speed     : 2.0000 (deg/min)
  sampling pitch : 0.0200 (deg)
  preset time    : 0.60 (sec)

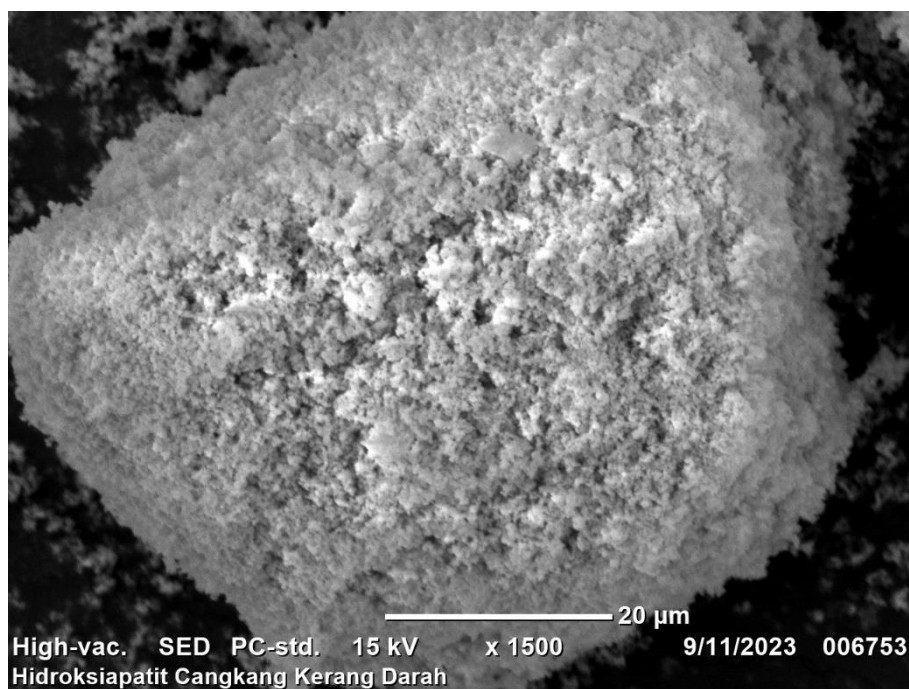
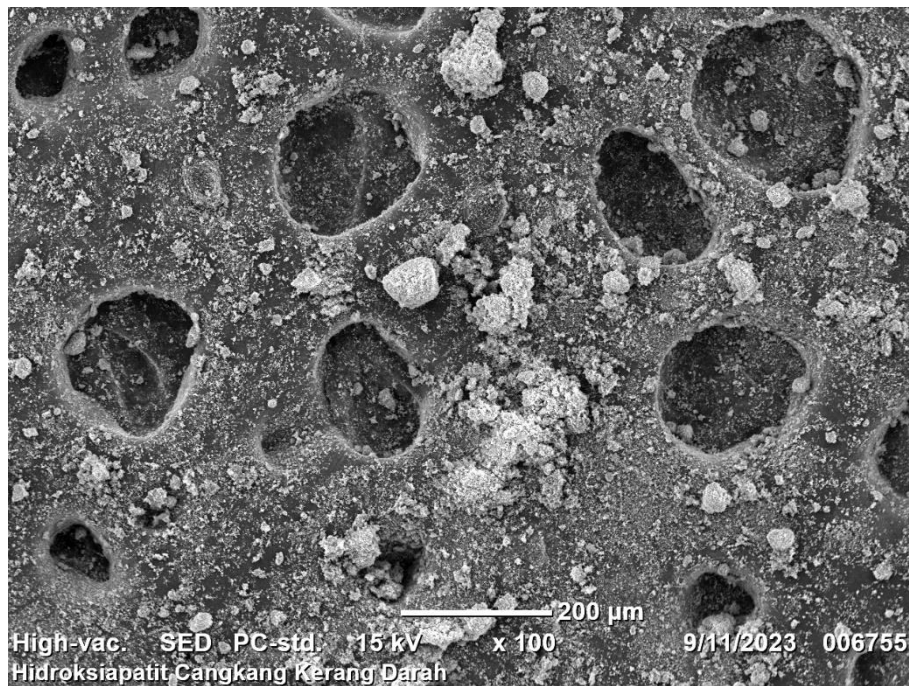
# Data Process Condition
  Smoothing      [ AUTO ]
  smoothing points : 13
  B.G.Subtruction [ AUTO ]
  sampling points : 13
  repeat times    : 30
  Kal-a2 Separate [ MANUAL ]
  Kal a2 ratio    : 50 (%)
  Peak Search     [ AUTO ]
  differential points : 13
  FWHM threhold   : 0.050 (deg)
  intensity threshold : 30 (par mil)
  FWHM ratio (n-1)/n : 2
  System error Correction [ NO ]
  Precise peak Correction [ NO ]
```

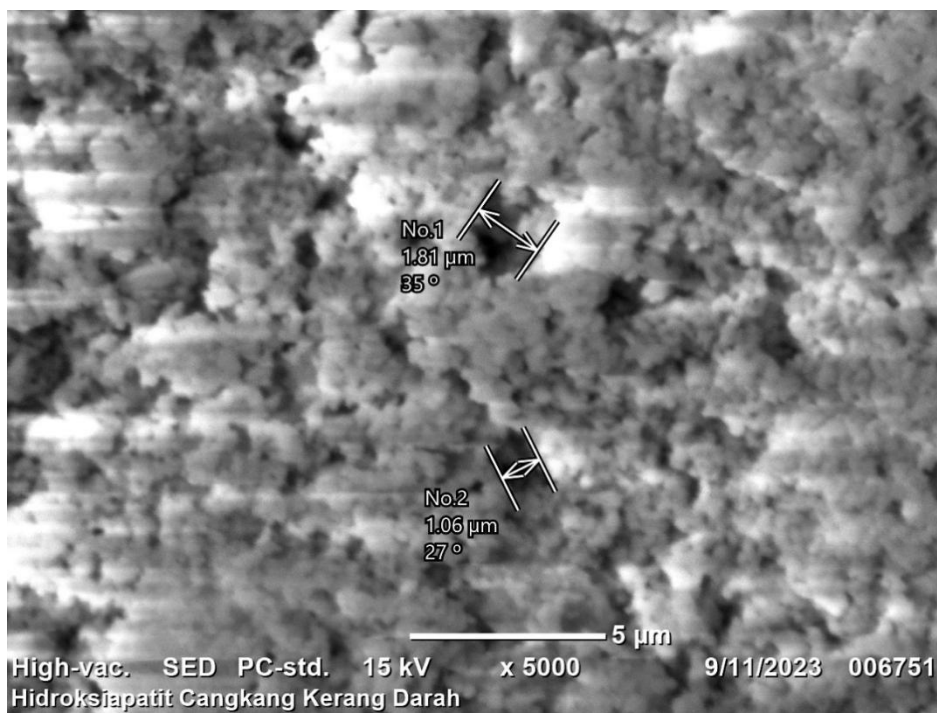
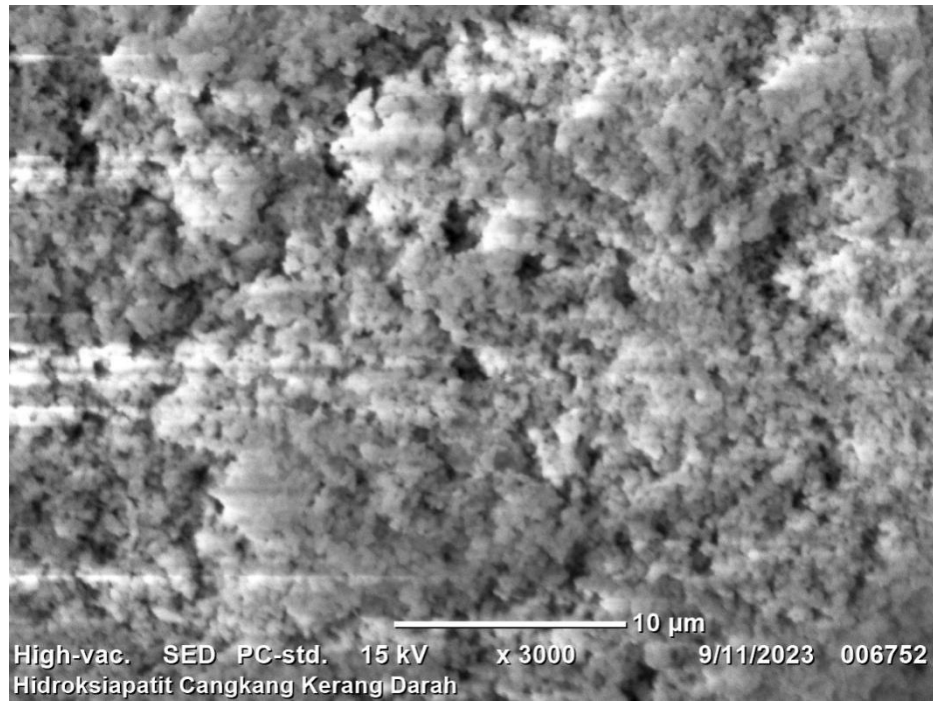
< Group: Standard Data: andriani#usman#161023 >



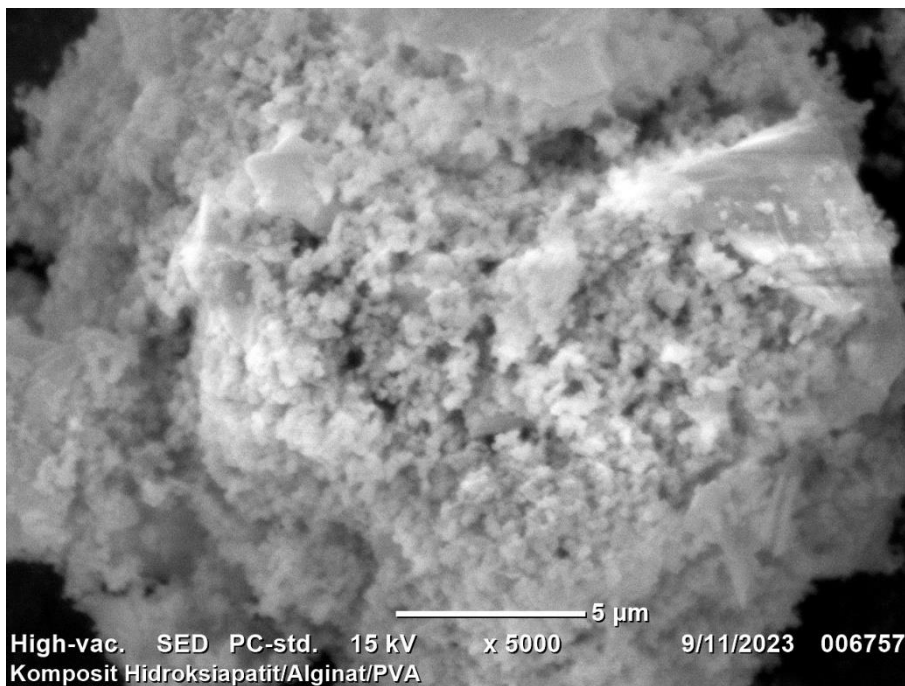
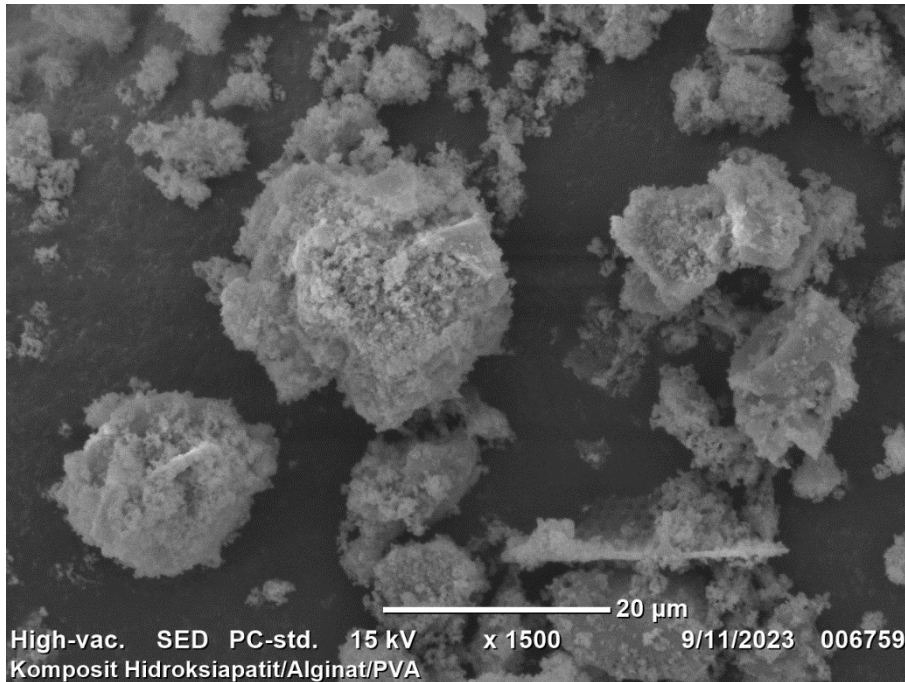
#### 4. Karakterisasi dengan SEM

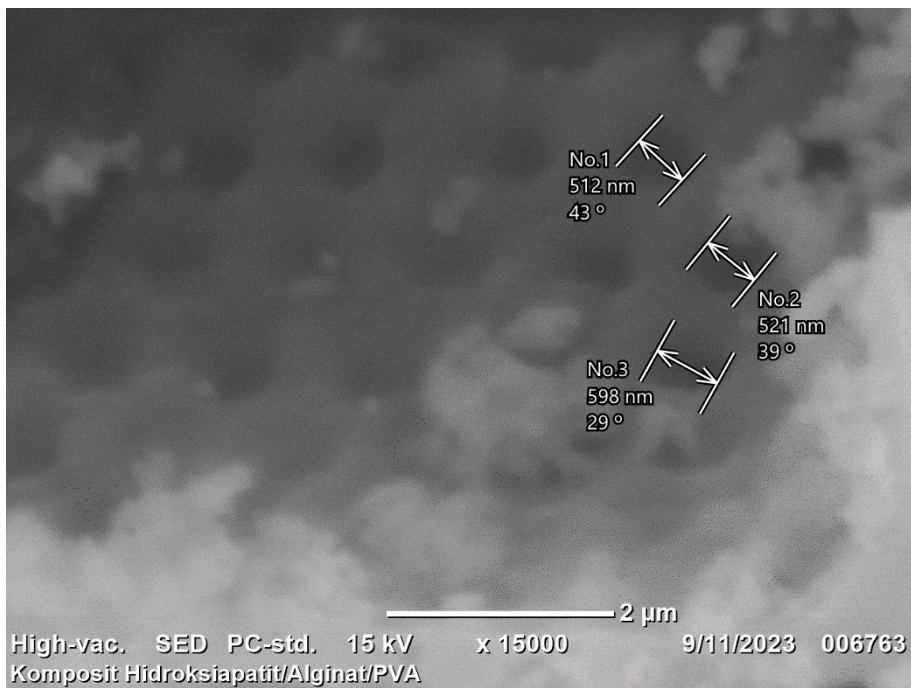
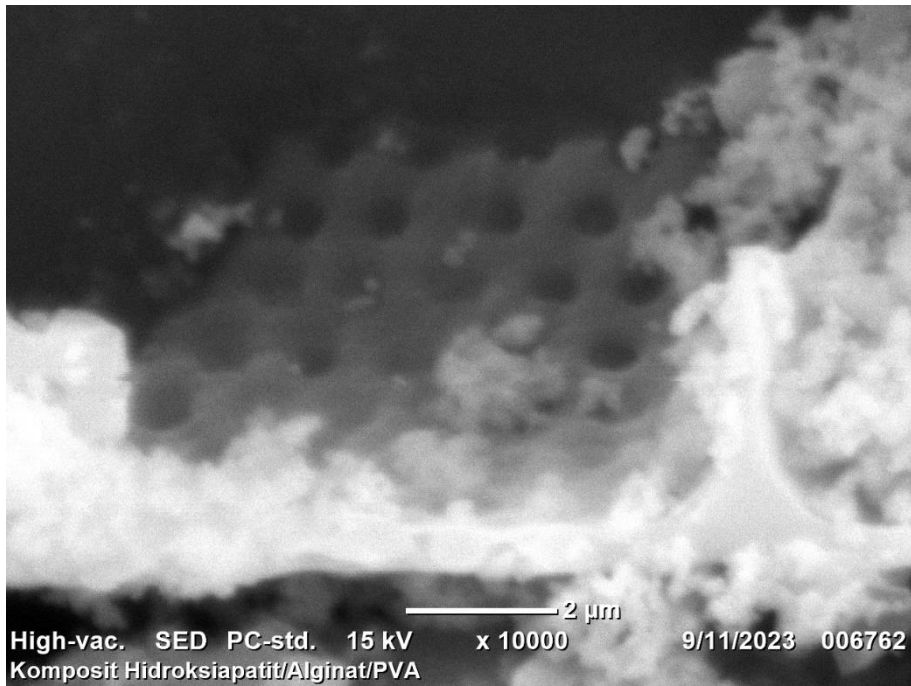
##### a. Hidroksiapatit dari CaO cangkang kerang darah







**b. Pelapis implan gigi hidroksiapatit/alginat/PVA**



5. Analisis uji mekanik pelapis implant gigi hidroksiapatit/  
alginat/PVA dengan *universal testing machine*



KEMENTERIAN PENDIDIKAN, KEBUDAYAAN,  
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Laman : [www.poliupg.ac.id/](http://www.poliupg.ac.id/) E-Mail : [pnup@poliupg.ac.id](mailto:pnup@poliupg.ac.id)

LABORATORIUM MEKANIK  
POLITEKNIK NEGERI UJUNG PANDANG

### HASIL PENGUJIAN KEKUATAN TEKAN

1. PEMESAN : Andriani Usman  
2. NIM : H012211011  
3. INSTITUSI : Prodi Kimia, MIPA, Univ. Hasanuddin  
4. JENIS SPESIMEN UJI : Material Pelapis Implan Gigi  
5. TANGGAL PENGUJIAN : 21 Agustus 2023  
6. PENGUJI : H. Muhlis, ST

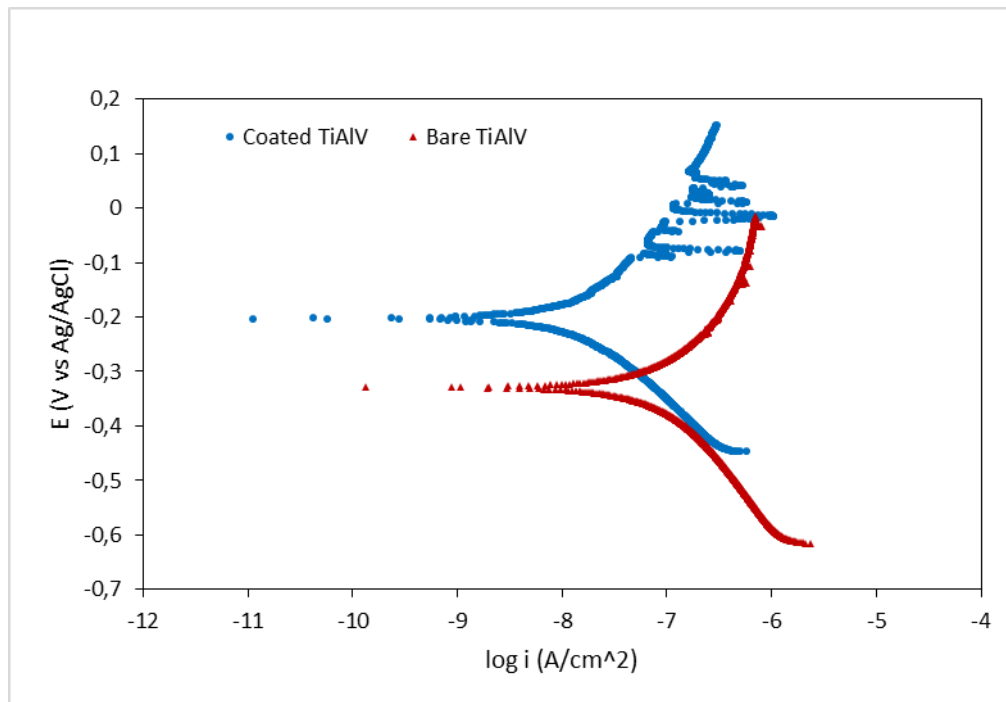
SPESIMEN UJI	KETERANGAN
Standar Pengujian	ISO
Standar Benda Uji	ISO
Tebal Spesimen Uji (mm)	7,2
Lebar Spesimen Uji (mm)	13,1
Luas Penampang Uji (mm <sup>2</sup> )	94,32
Beban Tekan Maksimum (N)	5.000
Kekuatan Tekan Maksimum (N/mm <sup>2</sup> )	53,011



21 Agustus 2023  
Laboratorium Mekanik

(Ahmad Zubair Sultan, ST., MT., PhD)  
NIP. 197404231999031002

## 6. Analisis uji ketahanan korosi pelapis implant gigi hidroksiapatit/ alginat/PVA dengan *potensiostat corrtest CS350*



	Bare TiAlV	Coated TiAlV
Potensial korosi (V vs (Ag/AgCl))	-0.328	-0.203
Rapat arus korosi (A/cm <sup>2</sup> )	1.068E-07	1.807E-08

Uji Potentiodynamic Polarization dengan alat Potensiostat Corrtest CS350

Elektroda kerja: sampel TiAlV (bare) dan sampel TiAlV dengan lapisan coating (coated)

Elektroda acuan: Ag/AgCl

Elektroda bantu: Platina

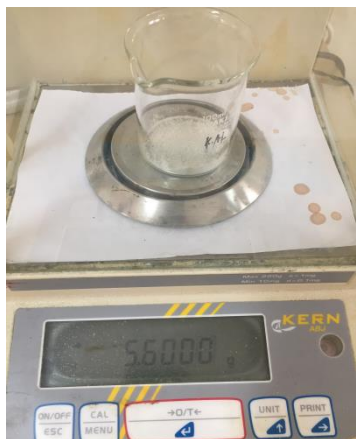
Elektrolit: larutan ringer laktat

Hasil: sampel coated TiAlV menunjukkan rapat arus korosi yang lebih rendah dan potensial korosi yang lebih positif dibandingkan sampel bare TiAlV. Hal ini mengindikasikan sampel coated TiAlV memiliki ketahanan korosi yang lebih baik dibandingkan sampel bare TiAlV. Namun, hasil polarisasi sampel coated TiAlV kurang baik, terlihat dari nilai arus yang kurang stabil pada potensial yang semakin positif. Hal ini disebabkan karena lapisan coating yang mengalami perubahan volume selama proses pengujian. Lapisan coating menyerap air dan terlihat menggelembung saat dicelupkan ke dalam larutan.

**LAMPIRAN 3. Dokumentasi Penelitian**  
**1. Preparasi cangkang kerang darah**

	
<p><b>Sampel cangkang kerang darah</b></p>	<p><b>Sampel cangkang kerang darah dibersihkan</b></p>
	
<p><b>Sampel cangkang kerang darah dikeringkan pada suhu ruang</b></p>	<p><b>Sampel cangkang kerang darah dihaluskan hingga menjadi serbuk</b></p>
	
<p><b>Serbuk cangkang kerang darah dikeringkan menggunakan oven dengan suhu 150°C selama 1 jam</b></p>	<p><b>Cangkang kerang darah setelah kalsinasi (CaO) suhu 1000°C selama 5 jam</b></p>

## 2. Pembuatan larutan kalsium fosfat



CaO ditimbang 5,6 g



Ditambahkan aquabidest 100 mL,  
diaduk dengan kecepatan 400 rpm  
selama 2 jam pada suhu 40°C

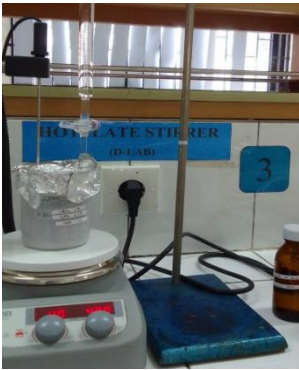









4,1 mL H<sub>3</sub>PO<sub>4</sub> 85%




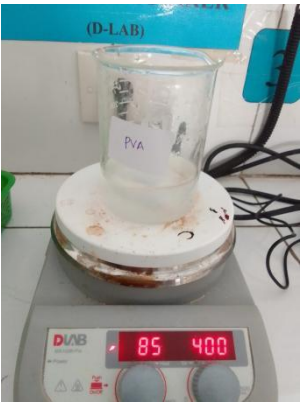

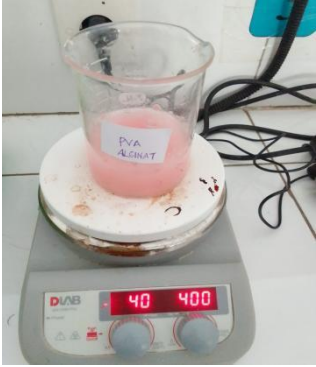
Ditambahkan aquabidest hingga  
volume mencapai 100 mL

### 3. Sintesis Hidroksiapatit dari CaO Cangkang Kerang Darah

	
<p>Dititrasi asam fosfat (<math>\text{H}_3\text{PO}_4</math>) 0,6 M kedalam 100 mL kalsium hidroksida (<math>\text{Ca}(\text{OH})_2</math>) 1 M</p>	<p>Dihangatkan pada suhu <math>60^\circ\text{C}</math> selama 1 jam</p>
	
<p>Ditambahkan NaOH 1 M sehingga diperoleh pH 10</p>	<p>Didiamkan selama 24 jam pada suhu ruang</p>
	
<p>Disaring menggunakan kertas saring</p>	<p>Dikeringkan menggunakan oven pada suhu <math>110^\circ\text{C}</math> selama 2 jam</p>

	
<p>Dikalsinasi suhu 800°C 10 jam</p>	<p>Hidroksiapatit dari CaO cangkang kerang darah</p>

#### 4. Sintesis Komposit Hidroksiapatit/Alginat/PVA

	
<p>Ditimbang PVA sebanyak 0,5 g</p>	<p>Diaduk menggunakan pengaduk magnetik dengan laju pengadukan 400 rpm pada suhu <math>\pm 85^{\circ}\text{C}</math> selama kurang lebih 1 jam</p>
	
<p>Ditimbang alginat 1,5 g</p>	<p>Dimasukkan kedalam larutan PVA yang sudah homogen</p>





Ditambahkan serbuk hidroksiapatit sebanyak 3 g dalam larutan alginat/PVA yang sudah homogen



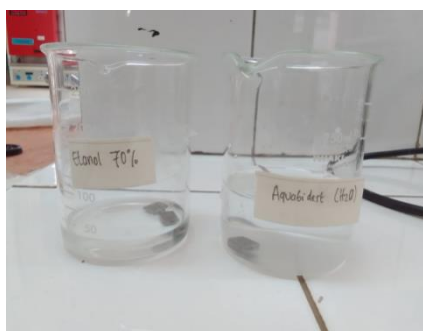
Diaduk menggunakan pengaduk magnetik dengan laju pengadukan 400 rpm selama 1 jam hingga homogen



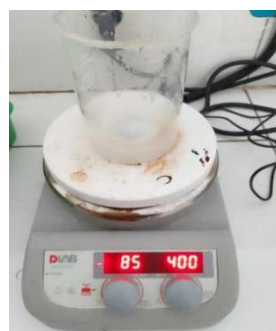
Dikeringkan pada suhu 110°C



Dipotong dengan ukuran panjang 1 cm, lebar 1 cm dan tebal 0,5 cm



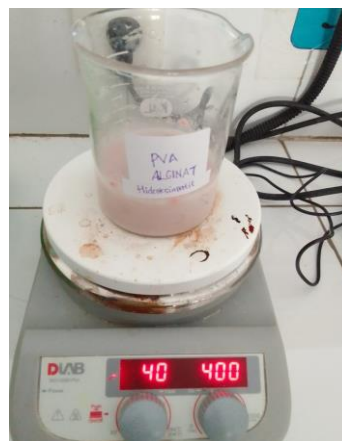
Dihaluskan dan dicuci menggunakan etanol 70% kemudian dibilas dengan aquabidest



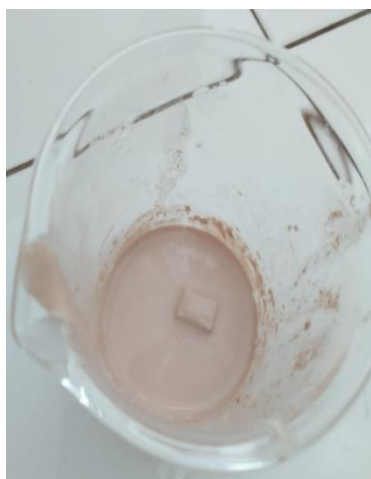
PVA ditimbang sebanyak 1 gram dan diaduk menggunakan pengaduk magnetik dengan laju pengadukan 400 rpm pada suhu  $\pm 85^{\circ}\text{C}$



**Ditimbang sebanyak 5 g komposit hidroksiapatit/alginat/PVA**





**Dimasukkan kedalam larutan PVA yang telah larut dan diaduk menggunakan pengaduk magnetik dengan laju pengadukan 400 rpm hingga larut**



**Dicelupkan logam Ti-6Al-4V kedalam larutan komposit hidroksiapatit/ alginat/PVA**



**Diangkat dari larutan komposit hidroksiapatit/alginat/PVA**

	
<p>Dikeringkan pada suhu 150°C selama 1 jam</p>	<p>Pelapis implan gigi</p>

### 5. Uji kuat tekan

	
<p>Dipasang pada tumpuan yang terdapat pada mesin</p>	<p>Ditekan dengan memperhatikan pembacaan pada alat ukur sampai mencapai gaya tekan maksimum</p>

## 6. Uji ketahanan korosi

	
<p><b>Dipasang logam Ti-6Al-4V pada kabel</b></p>	<p><b>Dilapisi loga Ti-6Al-4V</b></p>
	
<p><b>Dipasang rangkaian alat uji korosi dengan menggunakan tiga elektroda, sampel logam Ti-6Al-4V dan sampel logam Ti-6Al-4V terlapisi komposit hidroksiapatit/alginat/PVA sebagai elektroda kerja</b></p>	<p><b>Dibaca pada komputer</b></p>