

Tabel Perhitungan Densitas Teoritis Komposit Laminat Hibrid Al/SiC-Al/Al₂O₃

Komposit Al/SiC		Komposit Al/Al ₂ O ₃		Komposit Laminat Hibrid Al/SiC - Al/Al ₂ O ₃			Densitas Penyusun Komposit (gr/cm ³)			Densitas Komposit (gr/cm ³)
Vf Al (%)	Vf SiC (%)	Vf Al (%)	Vf Al ₂ O ₃ (%)	Vf Al (%)	Vf SiC (%)	Vf Al ₂ O ₃ (%)	Al	SiC	Al ₂ O ₃	
60,000	40,000	90,000	10,000	75,000	20,000	5,000	2,700	2,900	3,800	2,795
60,000	40,000	80,000	20,000	70,000	20,000	10,000	2,700	2,900	3,800	2,850
60,000	40,000	70,000	30,000	65,000	20,000	15,000	2,700	2,900	3,800	2,905
60,000	40,000	60,000	40,000	60,000	20,000	20,000	2,700	2,900	3,800	2,960

Tabel Perhitungan Densitas Eksperimental Komposit Laminat Hibrid Al/SiC-Al/Al₂O₃, T 600°C, 40% Vf SiC

Waktu Tahan (jam)	SAMPSEL		Berat Kering (gr)	Berat Dalam Air (gr)	Densitas Air (gr/cm ³)	Volume Sampel (cm ³)	Densitas Sampel (gr/cm ³)	Densitas rata-rata (gr/cm ³)	Standar Deviasi
	Vf Al ₂ O ₃ (%)								
6	10 A		3,940	1,724	1,000	1,724	2,285	2,284	0,035
	10 B		3,970	1,736	1,000	1,736	2,287		
	10 C		4,080	1,789	1,000	1,789	2,280		
	20 A		4,100	1,746	1,000	1,746	2,348	2,340	0,019
	20 B		4,100	1,740	1,000	1,740	2,356		
	20 C		4,110	1,775	1,000	1,775	2,315		
	30 A		4,210	1,746	1,000	1,746	2,411	2,434	0,021
	30 B		4,230	1,736	1,000	1,736	2,437		
	30 C		4,360	1,776	1,000	1,776	2,455		
	40 A		4,340	1,739	1,000	1,739	2,495	2,510	0,037
	40 B		4,360	1,750	1,000	1,750	2,491		
	40 C		4,280	1,682	1,000	1,682	2,545		
8	10 A		3,980	1,751	1,000	1,751	2,273	2,291	0,032
	10 B		3,970	1,690	1,000	1,690	2,349		
	10 C		3,910	1,737	1,000	1,737	2,251		
	20 A		4,150	1,722	1,000	1,722	2,410	2,357	0,025
	20 B		4,100	1,758	1,000	1,758	2,332		
	20 C		3,980	1,710	1,000	1,710	2,328		
	30 A		4,190	1,720	1,000	1,720	2,436	2,436	0,053
	30 B		4,280	1,754	1,000	1,754	2,440		
	30 C		4,010	1,650	1,000	1,650	2,431		
	40 A		4,330	1,688	1,000	1,688	2,565	2,518	0,039
	40 B		4,340	1,728	1,000	1,728	2,511		
	40 C		4,090	1,650	1,000	1,650	2,479		

(lanjutan)

Tabel Perhitungan Densitas Eksperimental Komposit Laminat Hibrid Al/SiC-Al/Al₂O₃, T 600°C, 40% Vf SiC

Waktu Tahan (jam)	SAMPSEL		Berat Kering (gr)	Berat Dalam Air (gr)	Densitas Air (gr/cm ³)	Volume Sampel (cm ³)	Densitas Sampel (gr/cm ³)	Densitas rata-rata (gr/cm ³)	Standar Deviasi
	Vf Al ₂ O ₃ (%)								
10	10 A		3,980	1,697	1,000	1,697	2,345	2,299	0,021
	10 B		3,940	1,715	1,000	1,715	2,297		
	10 C		3,920	1,738	1,000	1,738	2,255		
	20 A		4,170	1,732	1,000	1,732	2,408	2,391	0,023
	20 B		4,180	1,750	1,000	1,750	2,388		
	20 C		4,050	1,704	1,000	1,704	2,377		
	30 A		4,280	1,714	1,000	1,714	2,497	2,456	0,018
	30 B		4,280	1,741	1,000	1,741	2,459		
	30 C		4,220	1,750	1,000	1,750	2,412		
	40 A		4,310	1,741	1,000	1,741	2,476	2,526	0,030
	40 B		4,340	1,681	1,000	1,681	2,582		
	40 C		4,290	1,702	1,000	1,702	2,521		

Tabel Perhitungan Porositas Eksperimental Komposit Laminat Hibrid Al/SiC-Al/Al₂O₃, T 600°C, 40% Vf SiC

Waktu Tahan (jam)	SAMPSEL		Densitas Sampel (gr/cm ³)	Densitas Teoritis (gr/cm ³)	Porositas (%)	Porositas rata-rata (%)	Standar Deviasi	
	Vf Al ₂ O ₃ (%)							
6	10 A	2,285	2,795	18,247	18,283	0,129		
	10 B	2,287	2,795	18,175				
	10 C	2,280	2,795	18,426				
	20 A	2,348	2,850	17,614	17,906			
	20 B	2,356	2,850	17,333				
	20 C	2,315	2,850	18,772				
	30 A	2,411	2,905	17,005	16,202		0,761	
	30 B	2,437	2,905	16,110				
	30 C	2,455	2,905	15,491				
	40 A	2,495	2,960	15,709	15,191			1,017
	40 B	2,491	2,960	15,845				
	40 C	2,545	2,960	14,020				
8	10 A	2,273	2,795	18,676	18,032	1,840		
	10 B	2,349	2,795	15,957				
	10 C	2,251	2,795	19,463				
	20 A	2,410	2,850	15,439	17,310			
	20 B	2,332	2,850	18,175				
	20 C	2,328	2,850	18,316				
	30 A	2,436	2,905	16,145	16,156		0,155	
	30 B	2,440	2,905	16,007				
	30 C	2,431	2,905	16,317				
	40 A	2,565	2,960	13,345	14,921			1,468
	40 B	2,511	2,960	15,169				
	40 C	2,479	2,960	16,250				

(lanjutan)

Tabel Perhitungan Porositas Eksperimental Komposit Laminat Hibrid Al/SiC-Al/Al₂O₃, T 600°C, 40% Vf SiC

SAMPSEL		Waktu Tahan (jam)	Vf Al ₂ O ₃ (%)	Densitas Sampel (gr/cm ³)	Densitas Teoritis (gr/cm ³)	Porositas (%)	Porositas rata-rata (%)	Standar Deviasi
		10 B	2,297	2,795	17,818			
		10 C	2,255	2,795	19,320			
		20 A	2,408	2,850	15,509	16,105	0,551	
		20 B	2,388	2,850	16,211			
		20 C	2,377	2,850	16,596			
		30 A	2,497	2,905	14,045	15,456	1,466	
		30 B	2,459	2,905	15,353			
		30 C	2,412	2,905	16,971			
		40 A	2,476	2,960	16,351	14,651	1,797	
		40 B	2,582	2,960	12,770			
		40 C	2,521	2,960	14,831			

Tabel Perhitungan Modulus Elastisitas Eksperimental Komposit Laminat Hibrid Al/SiC-Al/Al₂O₃, T 600°C, 40% Vf SiC

Waktu Tahan (Jam)	SAMPLE		d (mm)	b (mm)	L (mm)	F (N)	h (mm)	m (N/mm)	L ³ (mm ³)	d ³ (mm ³)	4b (mm)	E (GPa)	E rata-rata (GPa)	Standar Deviasi
	Vf Al ₂ O ₃ (%)													
6	10 A		2,050	10,000	66,000	200,000	1,954	102,333	287496,000	8,615	40,000	85,374	85,569	2,760
	10 B		2,040	10,000	66,000	200,000	1,915	104,442	287496,000	8,490	40,000	88,421		
	10 C		2,070	10,000	66,000	200,000	1,955	102,319	287496,000	8,870	40,000	82,912		
	20 A		2,070	10,000	66,000	200,000	1,592	125,665	287496,000	8,870	40,000	101,830	101,279	5,676
	20 B		2,090	10,000	66,000	200,000	1,476	135,477	287496,000	9,129	40,000	106,659		
	20 C		2,080	10,000	66,000	200,000	1,675	119,378	287496,000	8,999	40,000	95,347		
	30 A		2,060	10,000	66,000	200,000	1,315	152,115	287496,000	8,742	40,000	125,067	123,608	4,947
	30 B		2,110	10,000	66,000	200,000	1,199	166,854	287496,000	9,394	40,000	127,662		
	30 C		2,150	10,000	66,000	200,000	1,225	163,297	287496,000	9,938	40,000	118,096		
	40 A		2,170	10,000	66,000	200,000	0,919	217,649	287496,000	10,218	40,000	153,091	146,793	6,902
	40 B		2,210	10,000	66,000	200,000	0,901	222,072	287496,000	10,794	40,000	147,873		
	40 C		2,210	10,000	66,000	200,000	0,955	209,370	287496,000	10,794	40,000	139,415		
8	10 A		2,090	10,000	66,000	200,000	1,680	119,082	287496,000	9,129	40,000	93,752	87,379	5,968
	10 B		2,070	10,000	66,000	200,000	1,874	106,702	287496,000	8,870	40,000	86,464		
	10 C		2,050	10,000	66,000	200,000	2,037	98,194	287496,000	8,615	40,000	81,921		
	20 A		2,100	10,000	66,000	200,000	1,511	132,323	287496,000	9,261	40,000	102,695	101,227	10,826
	20 B		2,090	10,000	66,000	200,000	1,415	141,300	287496,000	9,129	40,000	111,244		
	20 C		2,090	10,000	66,000	200,000	1,755	113,988	287496,000	9,129	40,000	89,741		
	30 A		2,130	10,000	66,000	200,000	1,095	182,676	287496,000	9,664	40,000	135,867	130,936	5,177
	30 B		2,150	10,000	66,000	200,000	1,101	181,691	287496,000	9,938	40,000	131,398		
	30 C		2,150	10,000	66,000	200,000	1,152	173,596	287496,000	9,938	40,000	125,544		
	40 A		2,150	10,000	66,000	200,000	0,959	208,480	287496,000	9,938	40,000	150,772	149,268	6,549
	40 B		2,190	10,000	66,000	200,000	0,883	226,416	287496,000	10,503	40,000	154,934		
	40 C		2,180	10,000	66,000	200,000	0,976	204,826	287496,000	10,360	40,000	142,098		

(lanjutan)

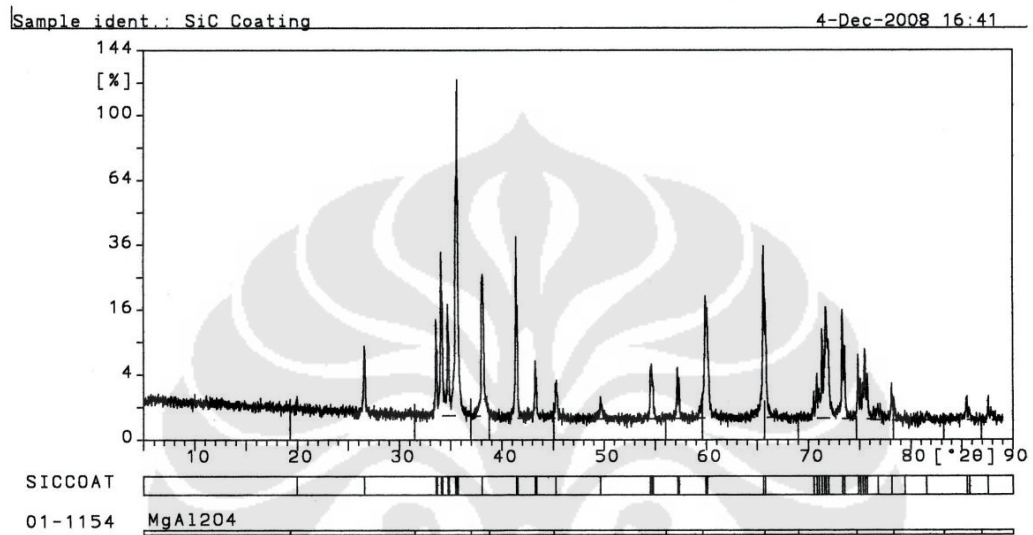
Tabel Perhitungan Modulus Elastisitas Eksperimental Komposit Laminat Hibrid Al/SiC-Al/Al₂O₃, T 600°C, 40% Vf SiC

SAMPLE		Waktu Tahan (Jam)	Vf Al ₂ O ₃ (%)	d (mm)	b (mm)	L (mm)	F (N)	h (mm)	m (N/mm)	L ³ (mm ³)	d ³ (mm ³)	4b (mm)	E (GPa)	E rata-rata (GPa)	Standar Deviasi
	10 A		10,000	2,080	66,000	200,000	1,739	115,027	287496,000	8,999	40,000	91,872	91,384	4,098	
	10 B		10,000	2,080	66,000	200,000	1,678	119,214	287496,000	8,999	40,000	95,216			
	10 C		10,000	2,060	66,000	200,000	1,889	105,893	287496,000	8,742	40,000	87,064			
	20 A		10,000	2,140	66,000	200,000	1,299	153,991	287496,000	9,800	40,000	112,934	106,777	6,895	
	20 B		10,000	2,090	66,000	200,000	1,457	137,268	287496,000	9,129	40,000	108,069			
	20 C		10,000	2,080	66,000	200,000	1,608	124,361	287496,000	8,999	40,000	99,327			
10	30 A		10,000	2,110	66,000	200,000	1,123	178,124	287496,000	9,394	40,000	136,285	134,919	4,497	
	30 B		10,000	2,160	66,000	200,000	1,029	194,299	287496,000	10,078	40,000	138,574			
	30 C		10,000	2,150	66,000	200,000	1,113	179,615	287496,000	9,938	40,000	129,897			
	40 A		10,000	2,180	66,000	200,000	0,887	225,533	287496,000	10,360	40,000	156,463	155,148	5,498	
	40 B		10,000	2,200	66,000	200,000	0,844	236,844	287496,000	10,648	40,000	159,870			
	40 C		10,000	2,170	66,000	200,000	0,943	211,992	287496,000	10,218	40,000	149,112			

Lampiran 5

Berkas Hasil Pengujian XRD

1. Pengujian XRD terhadap SiC yang telah dilapisi spinel



(lanjutan)

: SiCCoat.DI 4-Dec-2008 9:56
 =====
 Philips Analytical X-Ray B.V. Department of Metallurgy UI

Sample identification: SiC Coating
 Data measured at: 4-Dec-2008 8:46:00

Diffractometer type: PW1710 BASED
 Tube anode: Cu
 Generator tension [kV]: 40
 Generator current [mA]: 30
 Wavelength Alpha1 [Å]: 1.54056
 Wavelength Alpha2 [Å]: 1.54439
 Intensity ratio (alpha2/alpha1): 0.500
 Divergence slit: AUTOMATIC
 Irradiated length [mm]: 12
 Receiving slit: 0.2
 Monochromator used: YES

Start angle [°2θ]: 5.000
 End angle [°2θ]: 89.000
 Step size [°2θ]: 0.020
 Maximum intensity: 4121.640
 Time per step [s]: 1.000
 Type of scan: CONTINUOUS

Intensities converted to: FIXED

Minimum peak tip width: 0.00
 Maximum peak tip width: 1.00
 Peak base width: 2.00
 Minimum significance: 0.75
 Number of peaks: 48

Angle [°2θ]	d-value a1 [Å]	d-value a2 [Å]	Peak width [°2θ]	Peak int [counts]	Back. int [counts]	Rel. int [%]	Signif.
19.990	4.4381	4.4491	0.160	26	52	0.6	0.77
26.555	3.3539	3.3622	0.120	339	32	8.2	6.21
33.570	2.6674	2.6740	0.040	462	21	11.2	30.37
33.670	2.6597	2.6663	0.040	231	21	5.6	3.52
34.085	2.6282	2.6347	0.100	1163	19	28.2	8.84
34.185	2.6208	2.6273	0.040	605	19	14.7	4.01
34.715	2.5820	2.5884	0.060	576	19	14.0	2.67
34.820	2.5744	2.5808	0.040	299	19	7.3	3.88
35.500	2.5266	2.5329	0.060	2034	19	49.3	3.34
35.620	2.5184	2.5247	0.060	4122	19	100.0	6.22
35.730	2.5109	2.5171	0.040	1714	18	41.6	0.98
38.050	2.3630	2.3688	0.080	625	17	15.2	2.71
41.420	2.1782	2.1836	0.060	1018	13	24.7	4.22
41.535	2.1724	2.1778	0.060	471	13	11.4	3.10
43.265	2.0895	2.0946	0.060	154	13	3.7	1.59
43.380	2.0842	2.0894	0.060	77	12	1.9	1.02
45.250	2.0023	2.0073	0.060	67	12	1.6	2.58
49.650	1.8347	1.8392	0.060	28	10	0.7	1.78
54.540	1.6812	1.6853	0.060	102	9	2.5	0.86
54.665	1.6776	1.6818	0.060	108	9	2.6	0.81
54.795	1.6739	1.6781	0.060	52	9	1.3	0.77
57.190	1.6094	1.6134	0.060	98	9	2.4	1.27

(lanjutan)

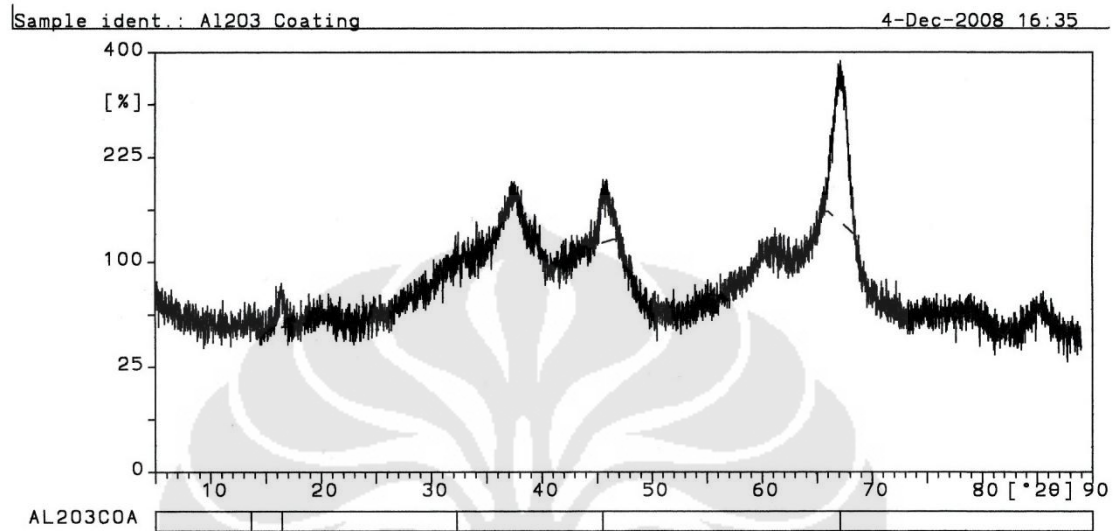
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Philips Analytical X-Ray B.V. Department of Metallurgy UI

Angle [°2θ]	d-value a1 [Å]	d-value a2 [Å]	Peak width [°2θ]	Peak int [counts]	Back. int [counts]	Rel. int [%]	Signif.
57.340	1.6055	1.6095	0.060	66	9	1.6	1.25
59.935	1.5421	1.5459	0.060	408	10	9.9	1.50
60.100	1.5382	1.5421	0.060	310	9	7.5	1.19
65.605	1.4219	1.4254	0.100	666	9	16.1	8.83
65.800	1.4181	1.4216	0.120	346	9	8.4	7.73
70.515	1.3344	1.3377	0.060	30	8	0.7	4.28
70.835	1.3291	1.3325	0.080	66	8	1.6	2.24
71.045	1.3257	1.3290	0.100	37	8	0.9	1.30
71.330	1.3211	1.3244	0.060	199	8	4.8	2.29
71.535	1.3179	1.3211	0.040	104	8	2.5	3.43
71.705	1.3151	1.3184	0.120	279	8	6.8	6.72
71.980	1.3108	1.3141	0.120	123	7	3.0	3.43
73.315	1.2902	1.2934	0.080	272	7	6.6	5.57
73.535	1.2869	1.2901	0.060	137	7	3.3	1.66
74.865	1.2673	1.2704	0.080	94	7	2.3	3.01
75.090	1.2640	1.2672	0.080	44	7	1.1	1.78
75.310	1.2609	1.2640	0.080	36	7	0.9	1.28
75.520	1.2579	1.2610	0.080	128	7	3.1	3.12
75.745	1.2547	1.2578	0.060	64	7	1.6	0.96
76.795	1.2402	1.2432	0.120	12	6	0.3	1.12
78.135	1.2222	1.2252	0.080	41	6	1.0	1.79
79.410	1.2058	1.2088	0.120	4	6	0.1	0.99
81.550	1.1794	1.1824	0.280	5	6	0.1	1.25
85.490	1.1349	1.1377	0.120	21	6	0.5	1.87
85.735	1.1323	1.1351	0.120	8	6	0.2	0.82
87.565	1.1132	1.1160	0.060	21	5	0.5	2.62

(lanjutan)

2. Pengujian XRD terhadap Al_2O_3 yang telah dilapisi spinel

(lanjutan)

AL2O3COA.DI 4-Dec-2008 12:56
 =====
 hilips Analytical X-Ray B.V. Department of Metallurgy UI

Sample identification: Al2O3 Coating
 Data measured at: 4-Dec-2008 11:39:00

Diffractometer type: PW1710 BASED
 Tube anode: Cu
 Generator tension [kV]: 40
 Generator current [mA]: 30
 Wavelength Alpha1 [Å]: 1.54056
 Wavelength Alpha2 [Å]: 1.54439
 Intensity ratio (alpha2/alpha1): 0.500
 Divergence slit: AUTOMATIC
 Irradiated length [mm]: 12
 Receiving slit: 0.2
 Monochromator used: YES

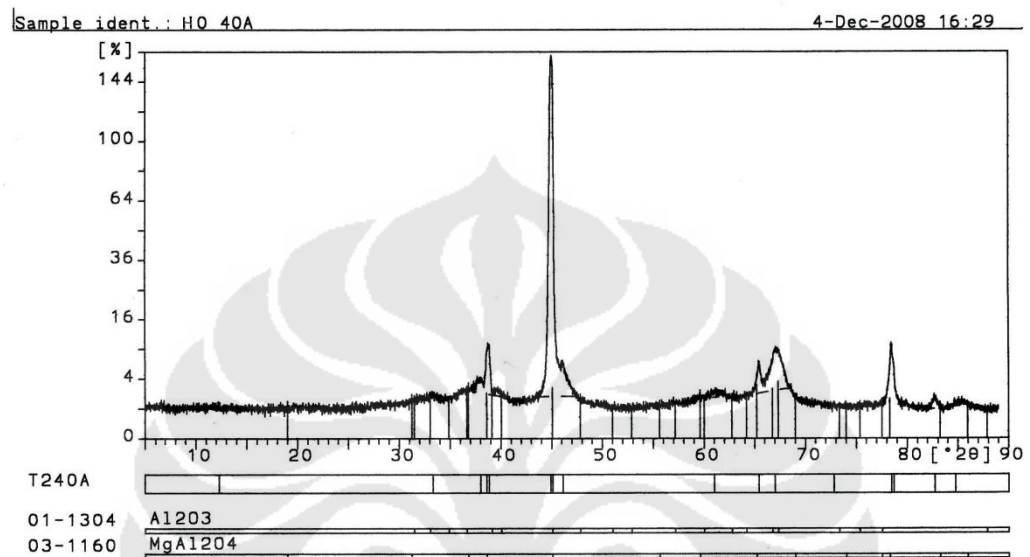
Start angle [°2θ]: 5.000
 End angle [°2θ]: 89.000
 Step size [°2θ]: 0.020
 Maximum intensity: 144.0000
 Time per step [s]: 1.000
 Type of scan: CONTINUOUS
 Intensities converted to: FIXED

Minimum peak tip width: 0.00
 Maximum peak tip width: 1.00
 Peak base width: 2.00
 Minimum significance: 0.75
 Number of peaks: 5

Angle [°2θ]	d-value α1 [Å]	d-value α2 [Å]	Peak width [°2θ]	Peak int [counts]	Back. int [counts]	Rel. int [%]	Signif.
13.655	6.4795	6.4956	0.960	18	146	12.2	1.08
16.455	5.3827	5.3960	0.320	61	121	42.2	1.00
32.270	2.7718	2.7787	0.400	14	123	10.0	0.86
45.500	1.9919	1.9968	0.320	52	112	36.0	0.85
67.070	1.3943	1.3978	0.240	144	94	100.0	0.84

(lanjutan)

3. Pengujian XRD terhadap Sampel Komposit Laminat Hibrid Al/SiC-Al/Al₂O₃ pada 40% Vf SiC dan 40% Vf Al₂O₃ Temperatur 600°C, Waktu Tahan 6 Jam.



(lanjutan)

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: H040A.DI                                     4-Dec-2008 14:37
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Philips Analytical X-Ray B.V.                 Department of Metallurgy UI

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Sample identification: H0 40A
Data measured at: 4-Dec-2008 13:27:00

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Diffractometer type: PW1710 BASED
Tube anode: Cu
Generator tension [kV]: 40
Generator current [mA]: 30
Wavelength Alpha1 [Å]: 1.54056
Wavelength Alpha2 [Å]: 1.54439
Intensity ratio (alpha2/alpha1): 0.500
Divergence slit: AUTOMATIC
Irradiated length [mm]: 12
Receiving slit: 0.2
Monochromator used: YES

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Start angle [°2θ]: 5.000
End angle [°2θ]: 89.000
Step size [°2θ]: 0.020
Maximum intensity: 4733.440
Time per step [s]: 1.000
Type of scan: CONTINUOUS
Intensities converted to: FIXED

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Minimum peak tip width: 0.00
Maximum peak tip width: 1.00
Peak base width: 2.00
Minimum significance: 0.75
Number of peaks: 16

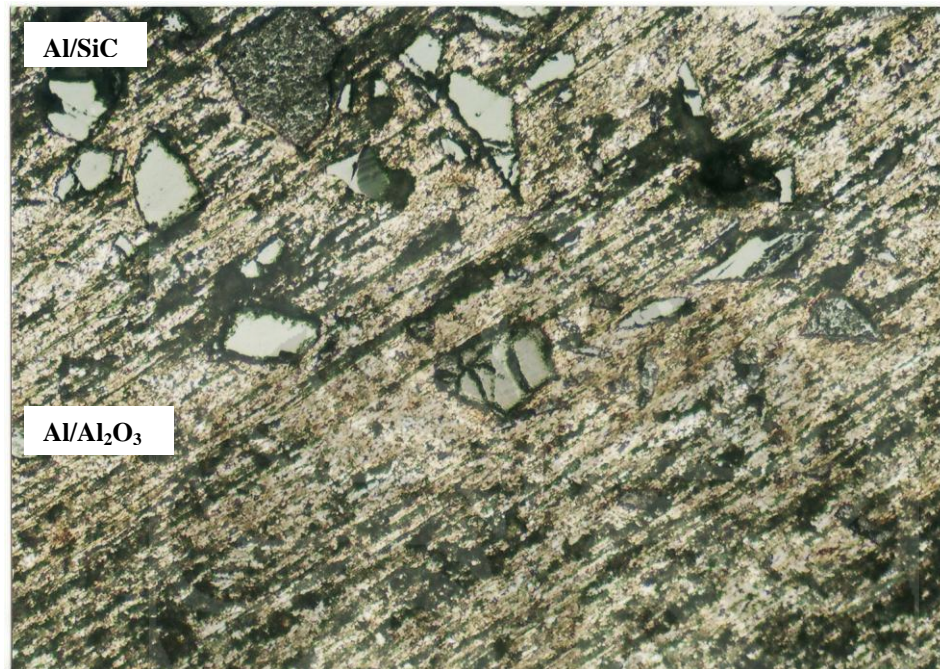
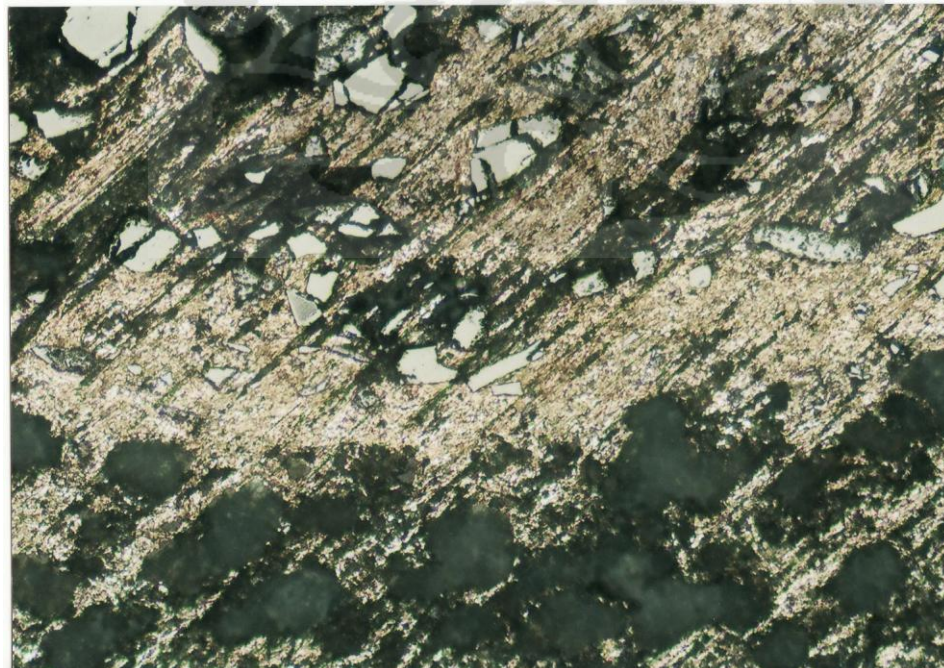
```

Angle [°2θ]	d-value α1 [Å]	d-value α2 [Å]	Peak width [°2θ]	Peak int [counts]	Back. int [counts]	Rel. int [%]	Signif.
12.280	7.2017	7.2196	0.240	8	114	0.2	0.91
33.325	2.6864	2.6931	0.640	16	76	0.3	1.11
38.030	2.3642	2.3700	0.480	58	86	1.2	2.05
38.610	2.3300	2.3358	0.200	222	81	4.7	2.27
38.875	2.3147	2.3204	0.060	276	79	5.8	1.72
44.890	2.0175	2.0225	0.200	4733	62	100.0	21.98
45.105	2.0084	2.0134	0.100	4610	62	97.4	6.31
46.115	1.9667	1.9716	0.160	139	61	2.9	0.92
61.030	1.5170	1.5208	0.960	12	44	0.2	1.70
65.385	1.4261	1.4296	0.200	92	49	1.9	2.29
66.990	1.3958	1.3992	0.800	132	55	2.8	14.37
72.785	1.2983	1.3015	0.200	4	23	0.1	0.98
78.440	1.2182	1.2212	0.060	166	24	3.5	1.14
78.675	1.2152	1.2182	0.140	100	24	2.1	1.08
82.705	1.1659	1.1688	0.400	15	18	0.3	2.09
84.745	1.1429	1.1458	0.640	5	19	0.1	0.78

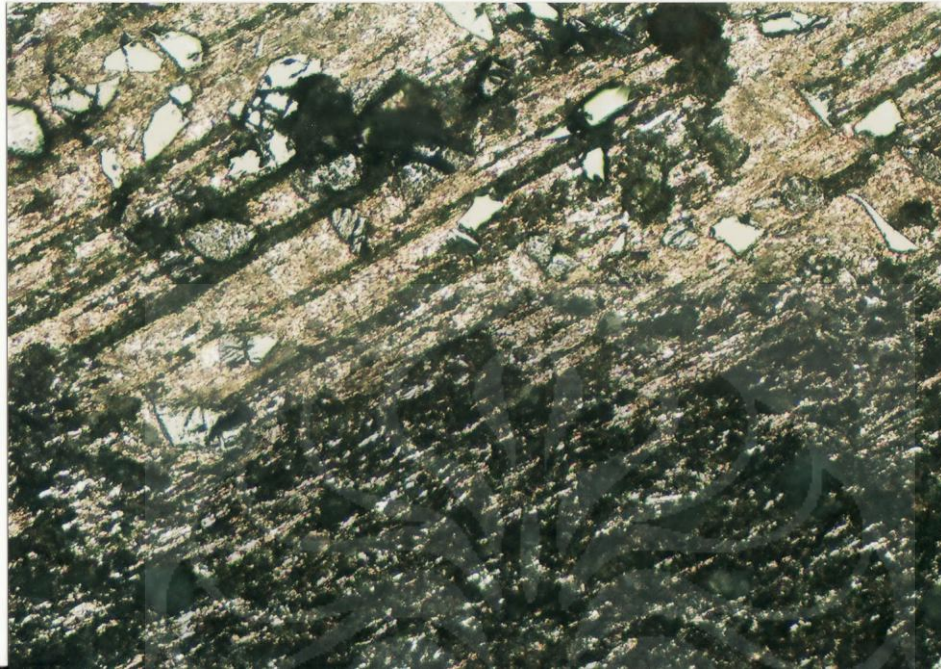
Lampiran 6

Foto Mikro Sampel Komposit Laminat Hibrid Al/SiC-Al/Al₂O₃

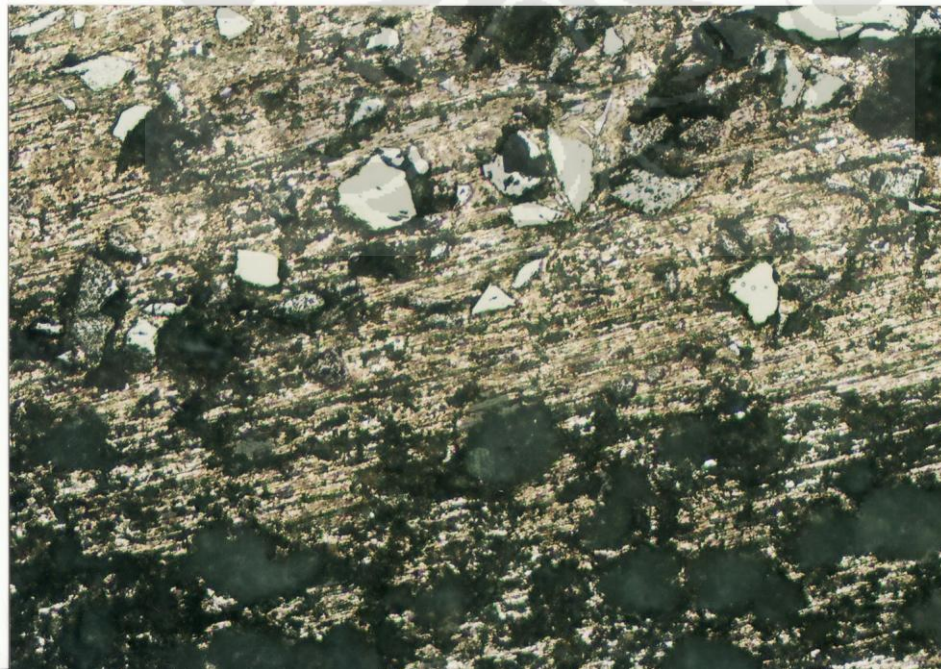
40% Vf SiC, T 600°C

1. Foto Mikro Sampel, Perbesaran 100 X, Waktu Tahan 6 Jam, 10 % Vf Al₂O₃2. Foto Mikro Sampel, Perbesaran 100 X, Waktu Tahan 6 Jam, 20 % Vf Al₂O₃

(lanjutan)

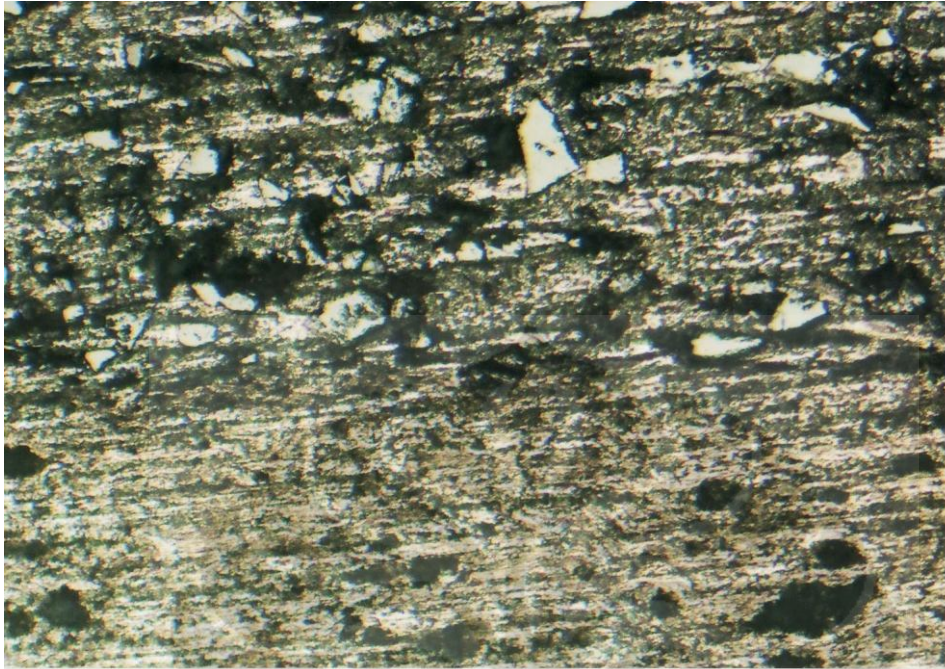


3. Foto Mikro Sampel, Perbesaran 100 X, Waktu Tahan 6 Jam, 30 % Vf Al₂O₃

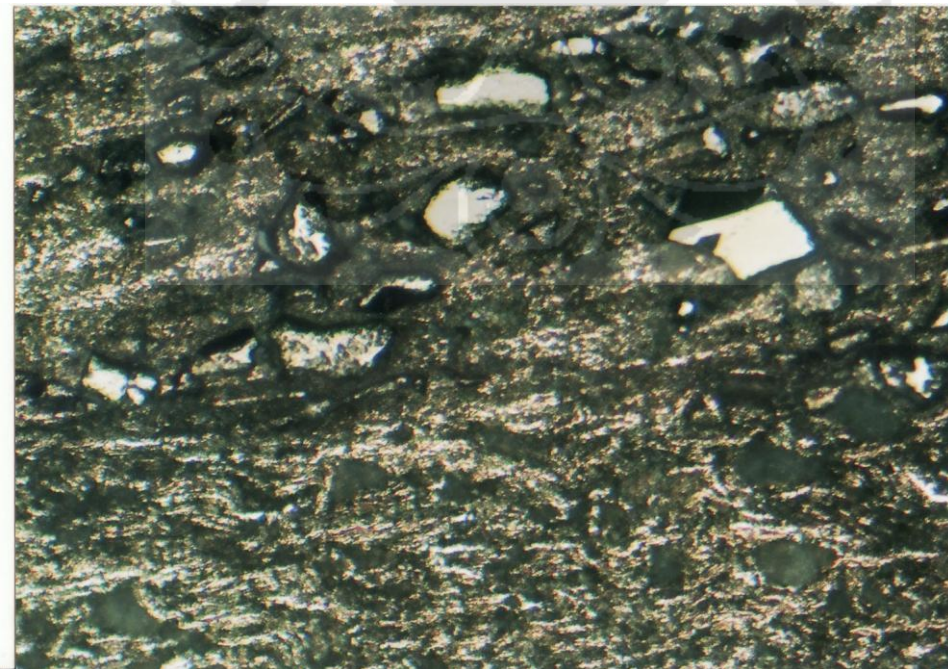


4. Foto Mikro Sampel, Perbesaran 100 X, Waktu Tahan 6 Jam, 40 % Vf Al₂O₃

(lanjutan)

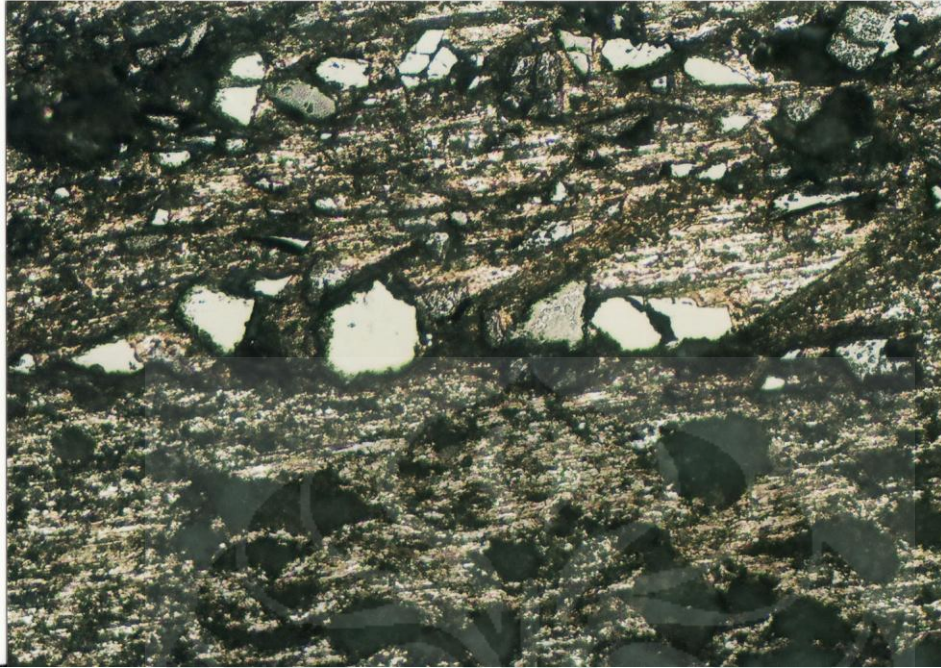


5. Foto Mikro Sampel, Perbesaran 100 X, Waktu Tahan 8 Jam, 10 % Vf Al₂O₃

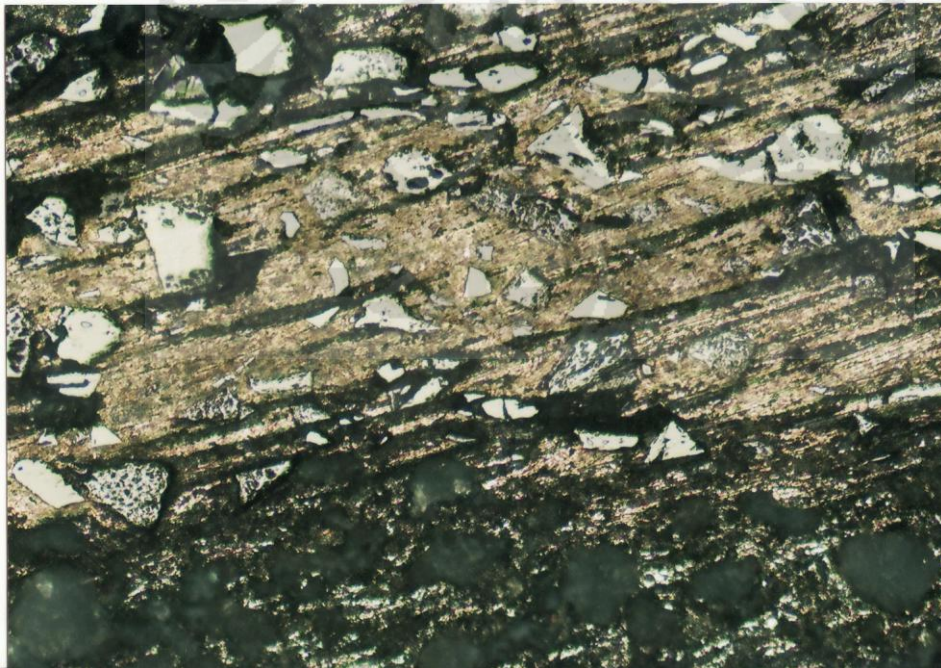


6. Foto Mikro Sampel, Perbesaran 100 X, Waktu Tahan 8 Jam, 20 % Vf Al₂O₃

(lanjutan)

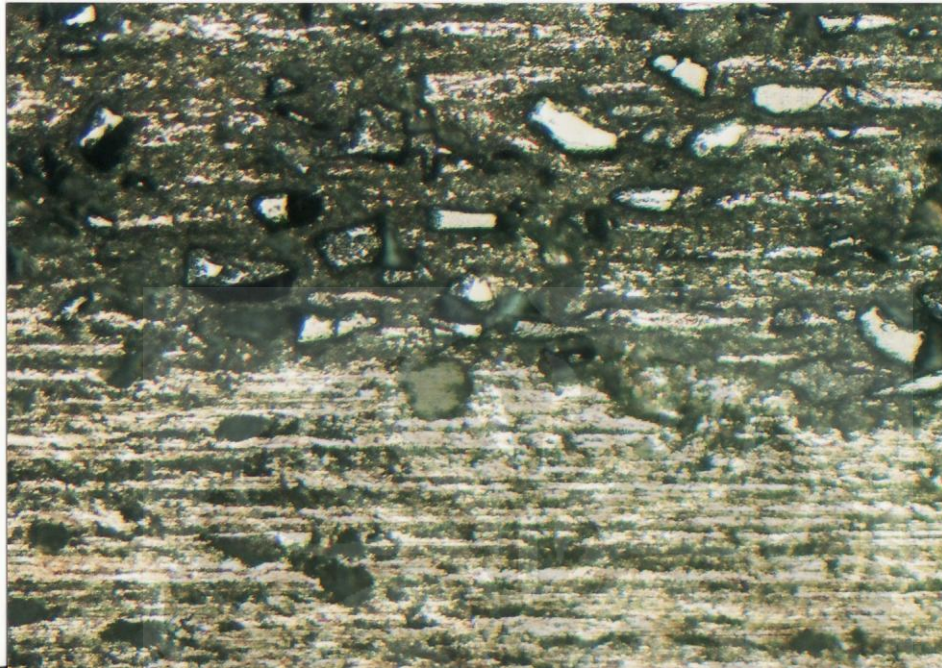


7. Foto Mikro Sampel, Perbesaran 100 X, Waktu Tahan 8 Jam, 30 % Vf Al₂O₃

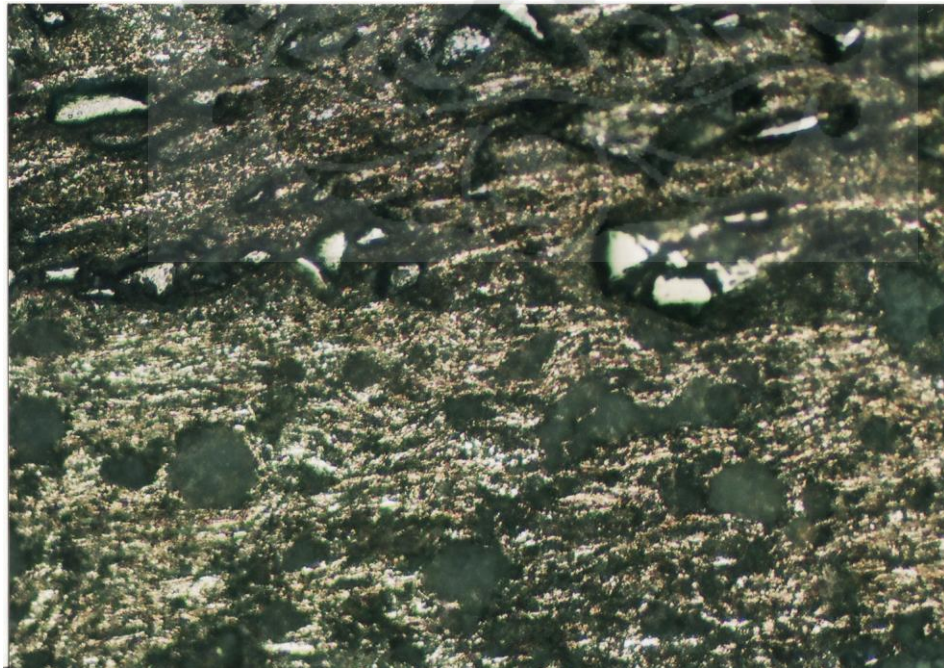


8. Foto Mikro Sampel, Perbesaran 100 X, Waktu Tahan 8 Jam, 40 % Vf Al₂O₃

(lanjutan)

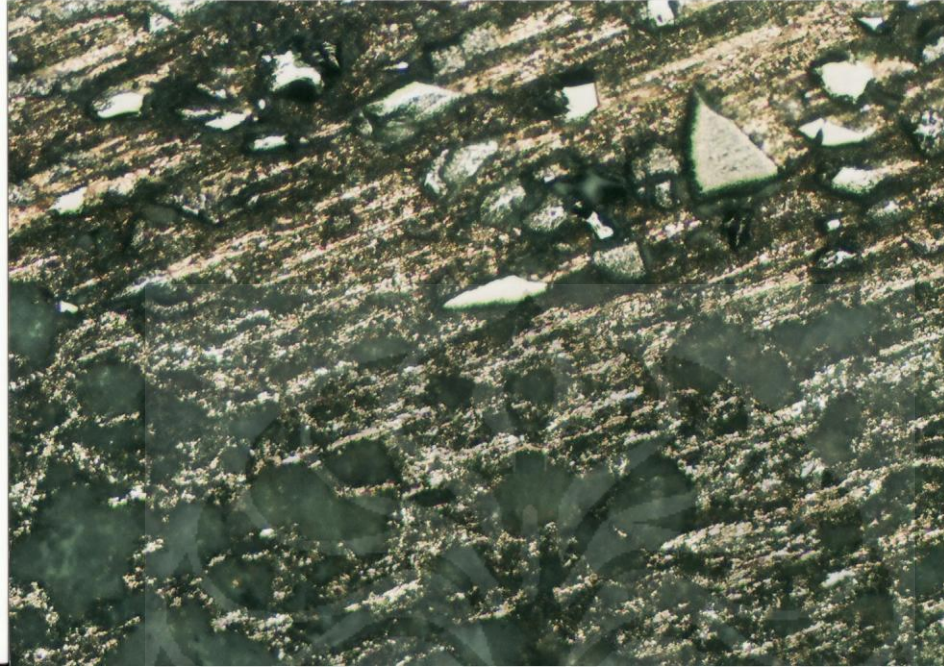


9. Foto Mikro Sampel, Perbesaran 100 X, Waktu Tahan 10 Jam, 10 % Vf Al₂O₃

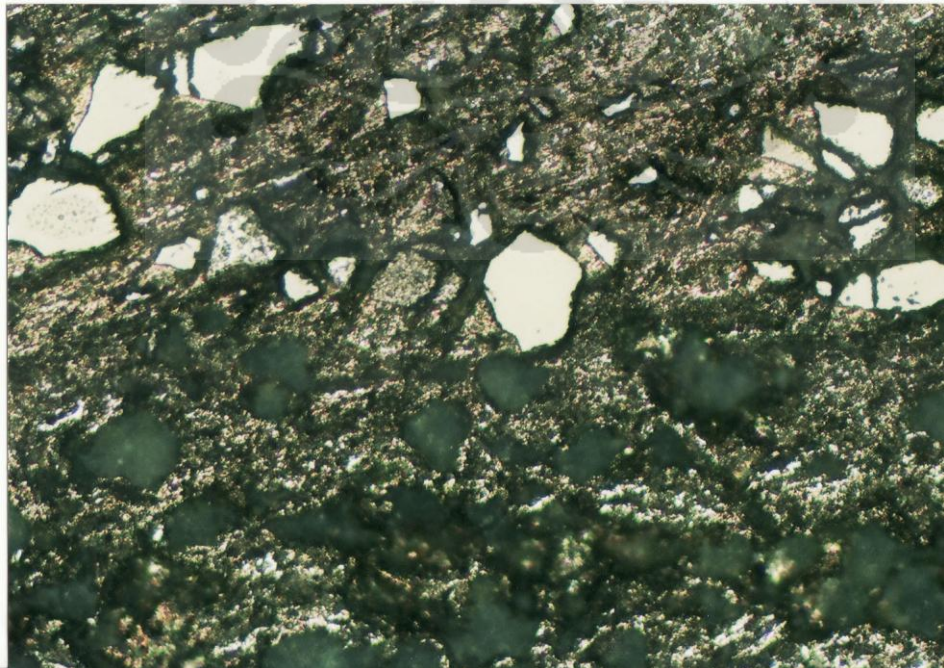


10. Foto Mikro Sampel, Perbesaran 100 X, Waktu Tahan 10 Jam, 20 % Vf Al₂O₃

(lanjutan)



11. Foto Mikro Sampel, Perbesaran 100 X, Waktu Tahan 10 Jam, 30 % Vf Al_2O_3



12. Foto Mikro Sampel, Perbesaran 100 X, Waktu Tahan 10 Jam, 40 % Vf Al_2O_3