

LAMPIRAN

LAMPIRAN A. HASIL PENGUJIAN PRODUKSI HIDROGEN DENGAN GAS CHROMATOGRAPHY

A.1. Perhitungan mol hidrogen dari data peak area

Pengukuran secara batch:

Volume syringe = 1 mL

$$\text{Volume hidrogen} = \frac{\text{Area}}{8415} \mu\text{L} \quad (\text{A.1-1})$$

Pengukuran secara kontinyu:

Volume tabung sampling GC = 0,5 mL

$$\text{Flow hidrogen} = \text{Flow Argon} \times \frac{1}{0,5} \times \frac{\text{Area}}{8415} \mu\text{L/s} \quad (\text{A.1-2})$$

$$PV = nRT$$

P = 1 atm

R = 0,082 atm liter/ mol K

T = Suhu pada saat sampling GC (K)

Maka mol produksi hidrogen dalam reaktor perdetik:

$$n/s = \left(\frac{P \times \text{Flow Hidrogen}}{RT} \right)$$

$$n/s = \left(\frac{1 \text{ atm} \times \frac{\text{Area}}{0,5 \times 8415} \mu\text{L}}{0,082 \frac{\text{atm L}}{\text{mol K}} \times T} \right)$$

$$n/s = \left(\frac{\text{Area}}{345,015 \times T} \mu\text{L} \right) \quad (\text{A.1-3})$$

Mol hidrogen/detik pada sampling ke m (n_m) adalah:

$$(n/s)_m = \left(\frac{\text{Area}}{345,015 \times T} \mu\text{L} \right) \quad (\text{A.1-4})$$

Total produksi hidrogen pada sampling ke m adalah:

$$N = N_{m-1} + \left(\left(\frac{(n/s)_m + (n/s)_{m-1}}{2} \right) \times s_m \right) \mu\text{L} \quad (\text{A.1-5})$$

Dimana:

s_m = selisih waktu antara sampling ke m dengan ke m-1

A.2. Data peak area uji produksi hidrogen untuk berbagai variasi

Kondisi Pengujian: Volume campuran 500 ml dengan 10% gliserol dan 90% air,

Konsentrasi fotokatalis 1 g/l, iradiasi sinar tampak.

Tabel A. 1. Tabel data uji produksi hidrogen dengan fotokatalis TiO₂ degussa P-25

waktu (jam)	Area	Mol H ₂ (μmol)	Suhu (°C)
0	0	0	28,05
0,25	549	0,19214	28,76
1	475	1,183939	34,95
2	1007	2,843746	39,89
3	2065	6,093005	42,86
4	1780	10,07689	44,36
5	2940	15,0068	44,7

Tabel A. 2. Tabel data uji produksi hidrogen dengan fotokatalis N-TiO₂

waktu (jam)	Area	Mol H ₂ (μmol)	Suhu (°C)
0	0	0	28,56
0,25	1122,5	0	34,94
1	2112	2,311711	42,75
2	3246,5	11,40772	46,37
3	2940	25,73668	46,88
4	4121,5	42,31003	45,26
5	0	52,52844	45,25

Tabel A. 3. Tabel data uji produksi hidrogen dengan fotokatalis Pt(1%)-N-TiO₂

waktu (jam)	Area	Mol H ₂ (μmol)	Suhu (°C)
0	1151	0	28,26
0,25	3609	1,357771	29,34
1	13333	17,66865	34,86
2	29163	72,09595	40,63
3	46476	183,0165	44,59
4	51182	337,4655	45,56
5	57170	503,1258	45,19

Tabel A. 4. Tabel data uji produksi hidrogen dengan fotokatalis Cu(1%)-N-TiO₂

waktu (jam)	Area	Mol H ₂ (μmol)	Suhu (°C)
0	0	0	27,5
0,25	554,5	0,215243	28,865
1	1234	2,295396	34,125
2	5832	12,2876	39,04
3	11197	35,89949	41,895
4	14244,5	70,44449	43,765
5	18841,5	115,6937	44,46

Tabel A. 5. Tabel data uji produksi hidrogen dengan fotokatalis Cu(3%)-N-TiO₂

waktu (jam)	Area	Mol H ₂ (μmol)	Suhu (°C)
0	0	0	31,27
0,25	218	0,097364	32,49
1	1609,5	2,237329	37,125
2	6771,5	14,88866	40,175
3	11725,5	42,76821	43,3
4	15963,5	84,73152	44,55
5	17653,5	110,3302	44,73

Tabel A. 6. Tabel data uji produksi hidrogen dengan fotokatalis Cu(5%)-N-TiO₂

waktu (jam)	Area	Mol H ₂ (μmol)	Suhu (°C)
0	1179	0	28,65
0,25	1683,5	1,456488	30,65
1	3490,5	7,919196	35,57
2	8189	24,90847	40,375
3	14100,5	57,18668	42,97
4	18226	103,632	43,73
5	21060	160,3579	44,89

Tabel A. 7. Tabel data uji produksi hidrogen dengan fotokatalis Cu(10%)-N- TiO₂

waktu (jam)	Area	Mol H ₂ (μmol)	Suhu (°C)
0	2725	0	29,71
0,25	2747,5	2,464934	31,5
1	2066	8,59458	35,66
2	6509	22,18588	40,905
3	10248,5	48,20187	43,58
4	11806	83,13083	44,795
5	14556	104,298	44,925

Tabel A. 8. Tabel data uji produksi hidrogen dengan fotokatalis Ni(1%)-N-TiO₂

waktu (jam)	Area	Mol H ₂ (μmol)	Suhu (°C)
0	0	0	28,04
0,25	3130	0,107622	28,95
1	3007,5	1,147698	36,56
2	5176,5	14,30038	41,855
3	11197	37,91227	41,895
4	8903,5	72,45727	46,775
5	12123,5	117,7064	47,56

Tabel A. 9. Tabel data uji produksi hidrogen dengan fotokatalis Ni(3%)-N-TiO₂

waktu (jam)	Area	Mol H ₂ (μmol)	Suhu (°C)
0	0	0	31,80
0,25	250	2,253148	32,53
1	681	5,821506	43,73
2	2045	16,05545	43,10
3	4208	43,84449	45,47
4	2510	78,68866	43,18
5	7903	120,6787	44,73

Tabel A. 10. Tabel data uji produksi hidrogen dengan fotokatalis Ni(5%)-N-TiO₂

waktu (jam)	Area	Mol H ₂ (μmol)	Suhu (°C)
0	2507	0	31,80
0,25	1913	3,848038	32,53
1	2377	14,76904	39,24
2	2076	28,52555	43,10
3	2724	54,58114	43,67
4	2724	84,94196	43,18
5	6060	125,9248	44,73

Tabel A. 11. Tabel data uji produksi hidrogen dengan fotokatalis Ni(10%)-N-TiO₂

waktu (jam)	Area	Mol H ₂ (μmol)	Suhu (°C)
0	1072	0	28,13
0,25	2870	2,930784	30,325
1	2544	13,79284	39,935
2	3115	30,0856	87,36
3	1570,5	50,32436	44,385
4	5747	81,64597	44,72
5	2137,5	113,7143	44,925

Tabel A. 12. Tabel data uji produksi hidrogen dengan fotokatalis Cu(5%)-N-TiO₂ dan konsentrasi gliserol 20%

waktu (jam)	Area	Mol H ₂ (μmol)	Suhu (°C)
0	1045	0	28,78
0,25	2600	2,86559	31,265
1	2779	15,38901	41,36
2	18066	52,36792	89,18
3	10965,5	117,158	45,535
4	17505,5	211,6889	46,865
4,5	12755	316,5102	47,325

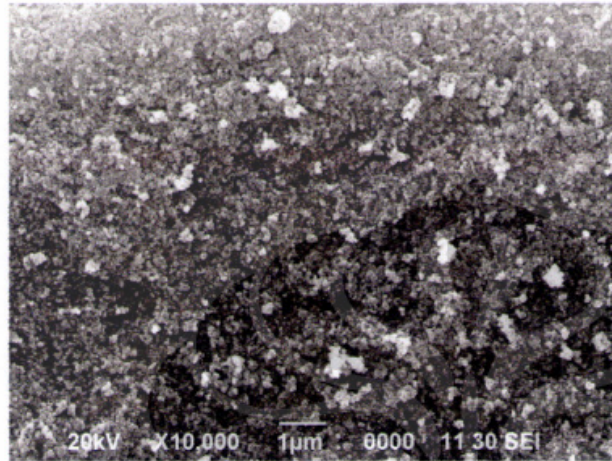
Tabel A. 13. Tabel data uji produksi hidrogen dengan fotokatalis Cu(5%)-N-TiO₂ dan konsentrasi gliserol 50%

waktu (jam)	Area	Mol H ₂ (μmol)	Suhu (°C)
0	0	0	30,08
0,25	0	0	32,325
1	965	7,919196	41,5
2	25048	31,92591	90,43
3	27017,5	201,2783	46,715
4	30768,5	473,3228	47,06
4,5	38713	754,4617	47,06

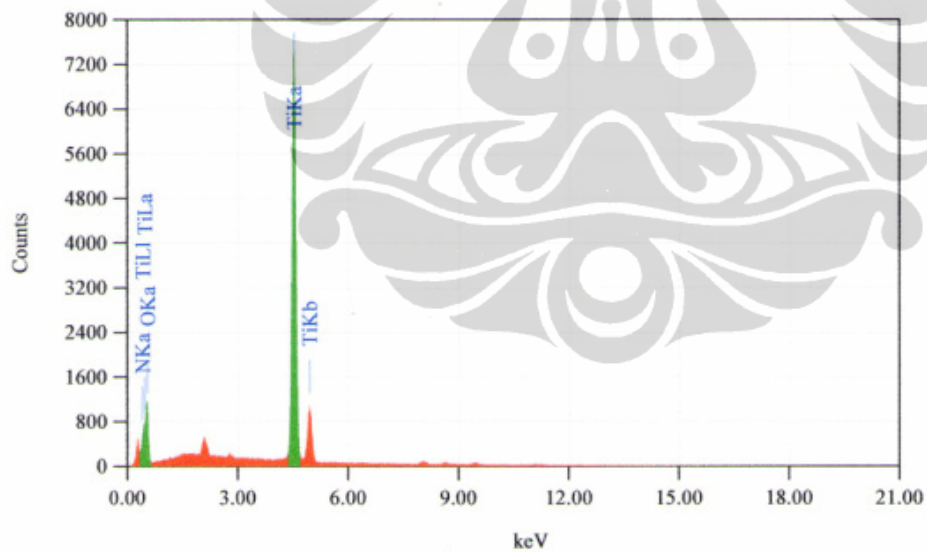
LAMPIRAN B. DATA KARAKTERISASI SEM-EDS

B.1. N-TiO₂ dengan larutan NH₃

13. Foto Permukaan Electron Microscope Titik 3 (perbesaran 10.000 x)



14. Grafik Analisis Kualitatif (Perbesaran 10.000 x)



15. Persentase Semi Quantitative Analysis

15.1. Pada Titik 1 Perbesaran 10.000 x

<u>Unsur</u> <i>Element</i>	<u>Massa Persentase / %</u> <i>Mass Prosentase / %</i>
N	0.97
O	35.29
Ti	63.74

15.2. Pada Titik 2 Perbesaran 10.000 x

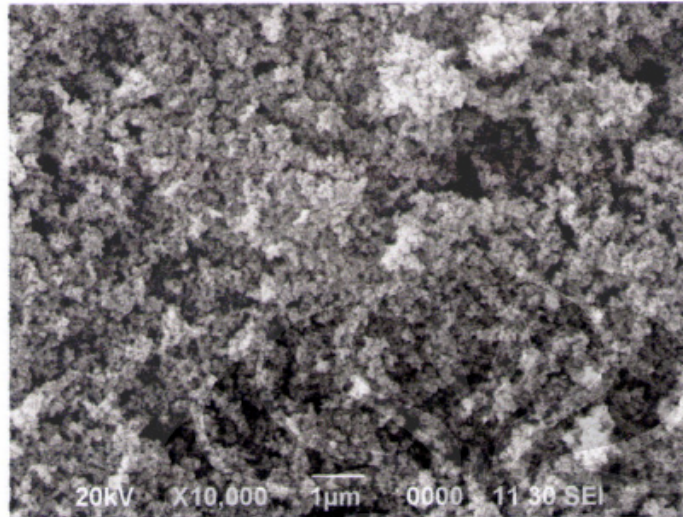
<u>Unsur</u> <i>Element</i>	<u>Massa Persentase / %</u> <i>Mass Prosentase / %</i>
N	0.82
O	39.54
Ti	59.64

15.3. Pada Titik 3 Perbesaran 10.000 x

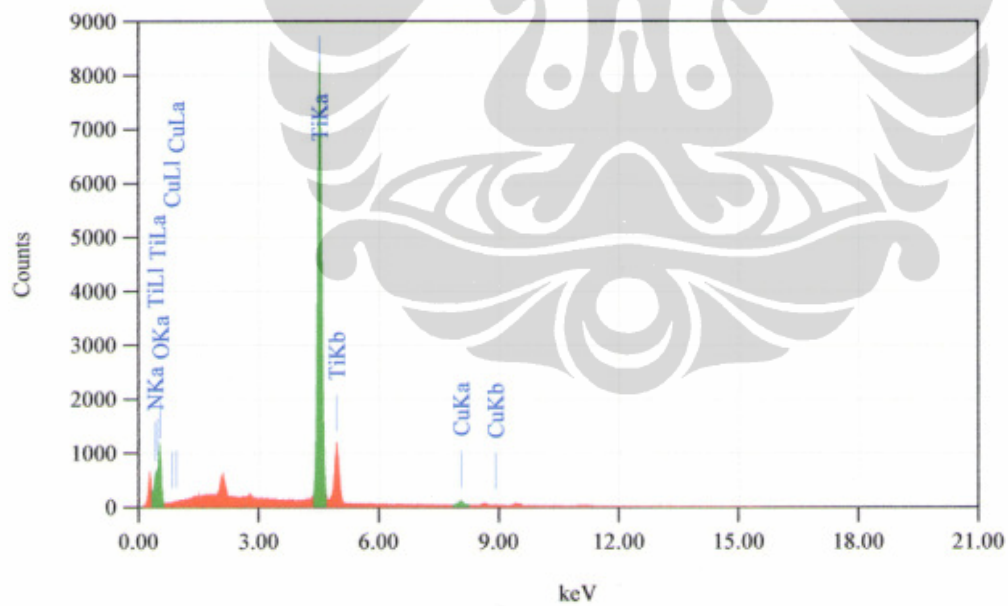
<u>Unsur</u> <i>Element</i>	<u>Massa Persentase / %</u> <i>Mass Prosentase / %</i>
N	0.60
O	37.72
Ti	61.68

B.2. N-TiO₂ dengan Gas NH₃

13. Foto Permukaan Electron Microscope Titik 3 (perbesaran 10.000 x)



14. Grafik Analisis Kualitatif (Perbesaran 10.000 x)



15.1. Pada Titik 1 Perbesaran 10.000 x

<u>Unsur</u> <i>Element</i>	<u>Massa Persentase / %</u> <i>Mass Prosentase / %</i>
N	0.17
O	36.90
Ti	62.93

15.2. Pada Titik 2 Perbesaran 10.000 x

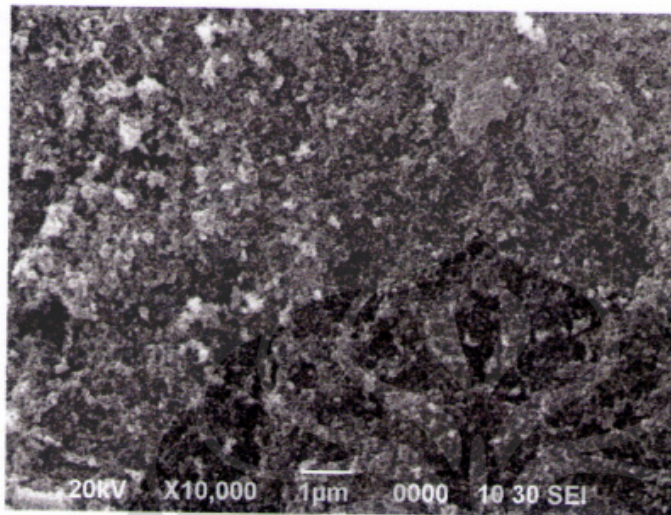
<u>Unsur</u> <i>Element</i>	<u>Massa Persentase / %</u> <i>Mass Prosentase / %</i>
N	0.01
O	46.59
Ti	51.29
Cu	2.11

15.3. Pada Titik 3 Perbesaran 10.000 x

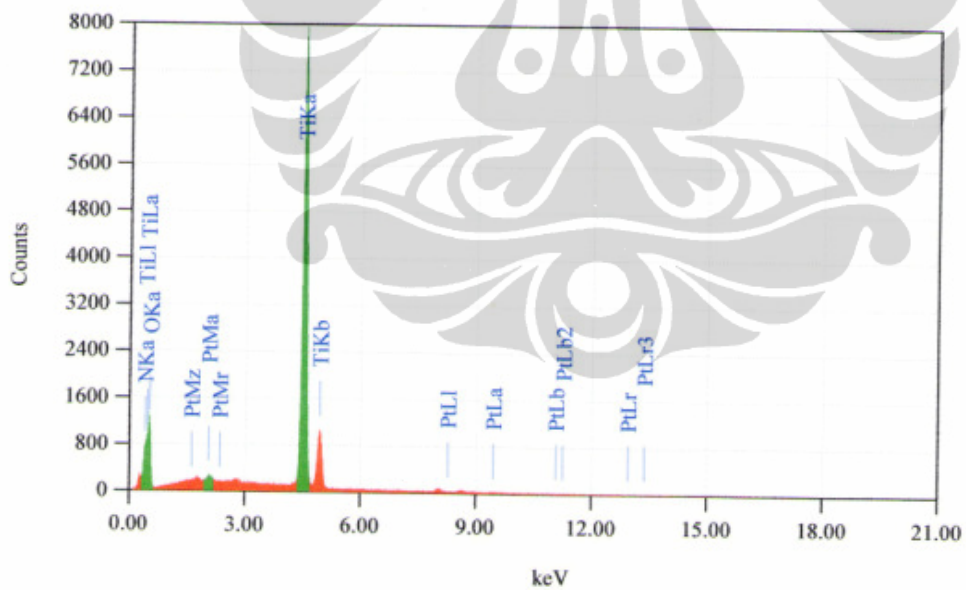
<u>Unsur</u> <i>Element</i>	<u>Massa Persentase / %</u> <i>Mass Prosentase / %</i>
N	1.07
O	34.47
Ti	62.25
Cu	2.21

B.3. Pt(1%)-N-TiO₂ (PAD)

13. Foto Permukaan Electron Microscope Titik 3 (perbesaran 10.000 x)



14. Grafik Analisis Kualitatif (Perbesaran 10.000 x)



15.1. Pada Titik 1 Perbesaran 10.000 x

<u>Unsur</u> <i>Element</i>	<u>Massa Persentase / %</u> <i>Mass Prosentase / %</i>
N	1.79
O	49.30
Ti	47.32
Pt	1.60

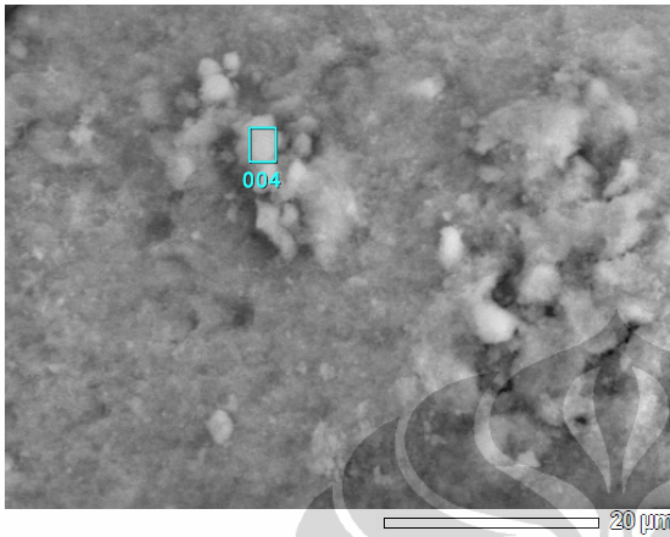
15.2. Pada Titik 2 Perbesaran 10.000 x

<u>Unsur</u> <i>Element</i>	<u>Massa Persentase / %</u> <i>Mass Prosentase / %</i>
N	1.09
O	51.87
Ti	45.67
Pt	1.36

15.3. Pada Titik 3 Perbesaran 10.000 x

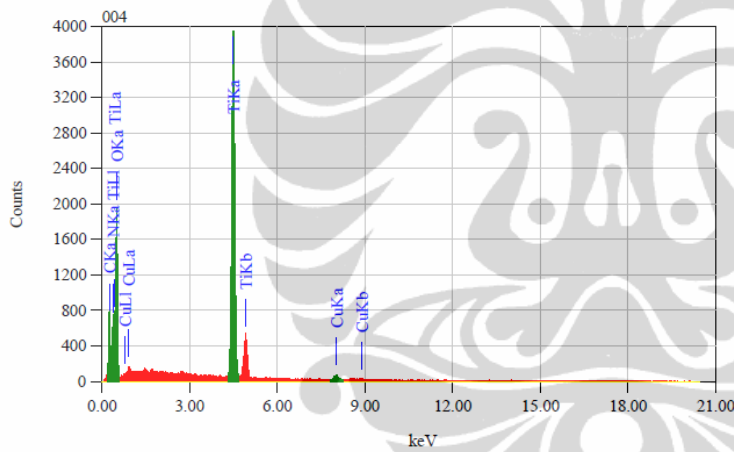
<u>Unsur</u> <i>Element</i>	<u>Massa Persentase / %</u> <i>Mass Prosentase / %</i>
N	1.34
O	36.06
Ti	61.37
Pt	1.23

B.4. Cu(1%)-N-TiO₂



Title : IMG1

 Instrument : 6510(LA)
 Volt : 20.00 kV
 Mag. : x 2,000
 Date : 2010/12/07
 Pixel : 512 x 384



Acquisition Parameter
 Instrument : 6510(LA)
 Acc. Voltage : 20.0 kV
 Probe Current : 1.00000 nA
 PHA mode : T4
 Real Time : 47.72 sec
 Live Time : 30.00 sec
 Dead Time : 36 %
 Counting Rate : 4469 cps
 Energy Range : 0 - 20 keV

ZAF Method Standardless Quantitative Analysis
 Fitting Coefficient : 0.2754

Element	(keV)	Mass%	Error%	Atom%	Compound	Mass%	Cation	K
C K	0.277	8.03	0.06	13.13				4.7116
N K	0.392	7.03	0.23	9.85				22.2514
O K	0.525	51.81	0.52	63.59				26.8923
Ti K	4.508	31.58	0.17	12.95				44.1560
Cu K	8.040	1.56	0.66	0.48				1.9888
Total		100.00		100.00				

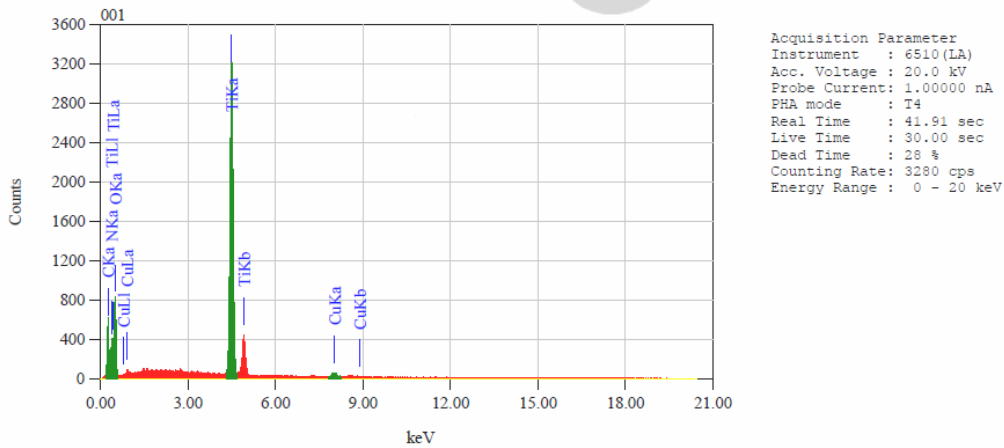
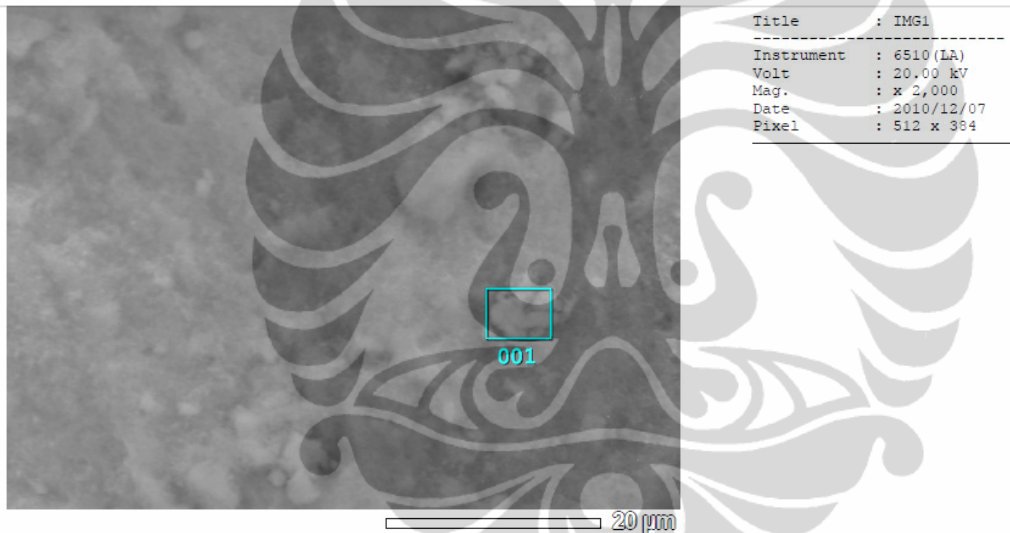
ZAF Method Standardless Quantitative Analysis
Fitting Coefficient : 0.2792

Element	(keV)	Mass%	Error%	Atom%	Compound	Mass%	Cation	K
C K	0.277	8.63	0.08	14.90				4.9381
N K	0.392	7.01	0.29	10.39				21.0349
O K	0.525	44.42	0.74	57.59				19.1902
Ti K	4.508	38.25	0.20	16.57				52.7222
Cu K	8.040	1.68	0.80	0.55				2.1147
Total		100.00		100.00				

ZAF Method Standardless Quantitative Analysis
Fitting Coefficient : 0.2772

Element	(keV)	Mass%	Error%	Atom%	Compound	Mass%	Cation	K
C K	0.277	8.14	0.07	13.94				4.6618
N K	0.392	6.89	0.26	10.11				21.2117
O K	0.525	46.28	0.64	59.51				20.8611
Ti K	4.508	36.94	0.19	15.87				51.0675
Cu K	8.040	1.74	0.73	0.56				2.1980
Total		100.00		100.00				

B.5. Cu(3%)-N-TiO₂



ZAF Method Standardless Quantitative Analysis
Fitting Coefficient : 0.2787

Element	(keV)	Mass%	Error%	Atom%	Compound	Mass%	Cation	K
C K	0.277	10.08	0.07	17.41				5.7705
N K*	0.392	7.87	0.30	11.66				21.9154
O K	0.525	41.17	0.75	53.40				16.6497
Ti K	4.508	39.18	0.20	16.97				53.5492
Cu K	8.040	1.70	0.77	0.56				2.1153
Total		100.00		100.00				

ZAF Method Standardless Quantitative Analysis
Fitting Coefficient : 0.2844

Element	(keV)	Mass%	Error%	Atom%	Compound	Mass%	Cation	K
C K	0.277	10.61	0.08	18.31				6.2121
N K	0.392	7.06	0.32	10.45				19.6220
O K	0.525	41.49	0.79	53.75				17.3168
Ti K	4.508	39.11	0.21	16.92				54.6550
Cu K	8.040	1.73	0.82	0.56				2.1940
Total		100.00		100.00				

ZAF Method Standardless Quantitative Analysis
Fitting Coefficient : 0.3140

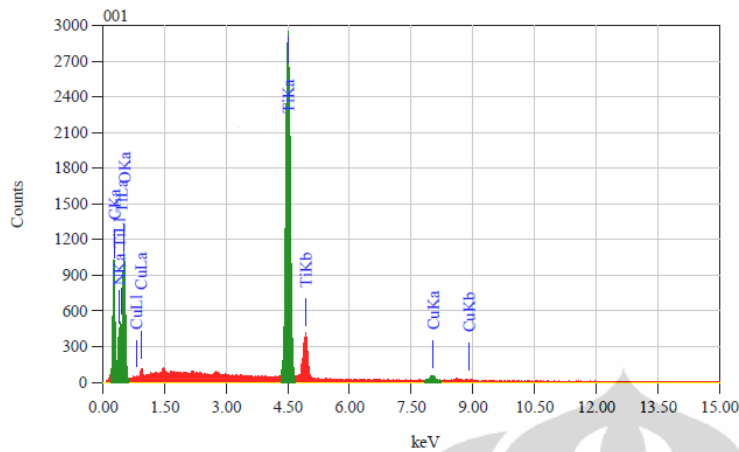
Element	(keV)	Mass%	Error%	Atom%	Compound	Mass%	Cation	K
C K	0.277	10.38	0.09	17.85				6.0378
N K	0.392	7.18	0.37	10.59				20.0866
O K	0.525	42.09	0.90	54.36				17.8235
Ti K	4.508	38.42	0.24	16.57				53.5933
Cu K	8.040	1.94	0.95	0.63				2.4587
Total		100.00		100.00				

B.6. Cu(5%)-N-TiO₂



Title : IMG1

Instrument : 6510(LA)
Volt : 20.00 kV
Mag. : x 2,000
Date : 2010/12/15
Pixel : 512 x 384



Acquisition Parameter
 Instrument : 6510 (LA)
 Acc. Voltage : 20.0 kV
 Probe Current: 1.00000 nA
 PHA mode : T4
 Real Time : 42.37 sec
 Live Time : 30.00 sec
 Dead Time : 29 %
 Counting Rate: 3339 cps
 Energy Range : 0 - 20 keV

ZAF Method Standardless Quantitative Analysis
 Fitting Coefficient : 0.2799

Element	(keV)	Mass%	Error%	Atom%	Compound	Mass%	Cation	K
C K	0.277	14.85	0.06	23.36				9.4537
N K*	0.392	10.16	0.31	13.71				24.6297
O K	0.525	42.55	0.59	50.26				19.4928
Ti K	4.508	31.01	0.17	12.23				44.5397
Cu K	8.040	1.44	0.66	0.43				1.8841
Total		100.00		100.00				

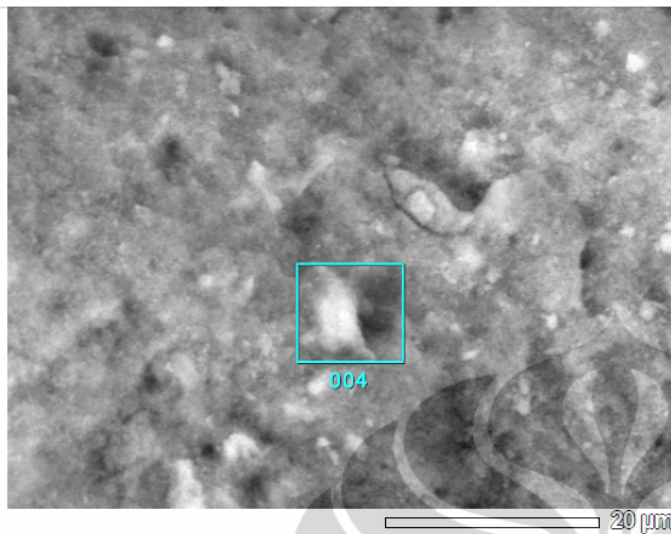
ZAF Method Standardless Quantitative Analysis
 Fitting Coefficient : 0.2745

Element	(keV)	Mass%	Error%	Atom%	Compound	Mass%	Cation	K
C K	0.277	18.34	0.07	30.53				11.5796
N K	0.392	8.68	0.42	12.40				18.1242
O K	0.525	32.19	0.85	40.22				12.0155
Ti K	4.508	39.09	0.20	16.32				56.0634
Cu K	8.040	1.70	0.77	0.54				2.2172
Total		100.00		100.00				

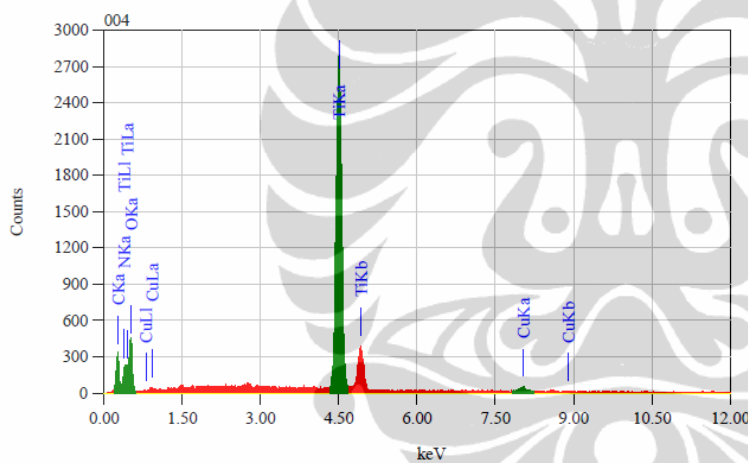
ZAF Method Standardless Quantitative Analysis
 Fitting Coefficient : 0.2875

Element	(keV)	Mass%	Error%	Atom%	Compound	Mass%	Cation	K
C K	0.277	17.38	0.07	28.55				10.9221
N K	0.392	9.36	0.40	13.19				20.2446
O K	0.525	34.47	0.81	42.50				13.5062
Ti K	4.508	36.81	0.20	15.16				52.7635
Cu K	8.040	1.97	0.77	0.61				2.5637
Total		100.00		100.00				

B.7. Cu(10%)-N-TiO₂



Title : IMG1
 Instrument : 6510(LA)
 Volt : 20.00 kV
 Mag. : x 2,000
 Date : 2010/12/15
 Pixel : 512 x 384



Acquisition Parameter
 Instrument : 6510(LA)
 Acc. Voltage : 20.0 kV
 Probe Current : 1.00000 nA
 PHA mode : T4
 Real Time : 39.11 sec
 Live Time : 30.00 sec
 Dead Time : 23 %
 Counting Rate : 2579 cps
 Energy Range : 0 - 20 keV

ZAF Method Standardless Quantitative Analysis
 Fitting Coefficient : 0.2621

Element	(keV)	Mass%	Error%	Atom%	Compound	Mass%	Cation	K
C K	0.277	8.70	0.09	16.60				4.6931
N K	0.392	5.63	0.32	9.21				15.9471
O K	0.525	35.08	0.95	50.24				12.1345
Ti K	4.508	48.51	0.22	23.21				64.7022
Cu K	8.040	2.09	0.86	0.75				2.5232
Total		100.00		100.00				

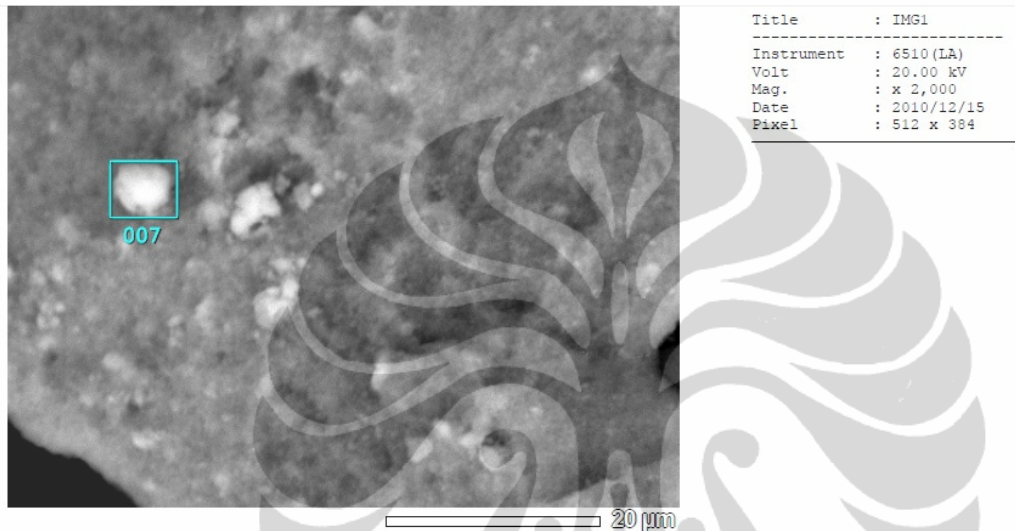
ZAF Method Standardless Quantitative Analysis
 Fitting Coefficient : 0.2727

Element	(keV)	Mass%	Error%	Atom%	Compound	Mass%	Cation	K
C K	0.277	9.14	0.09	17.43				4.9417
N K	0.392	5.79	0.35	9.47				16.0663
O K	0.525	34.26	1.06	49.04				11.6443
Ti K	4.508	48.84	0.24	23.35				64.9789
Cu K	8.040	1.96	0.94	0.71				2.3688
Total		100.00		100.00				

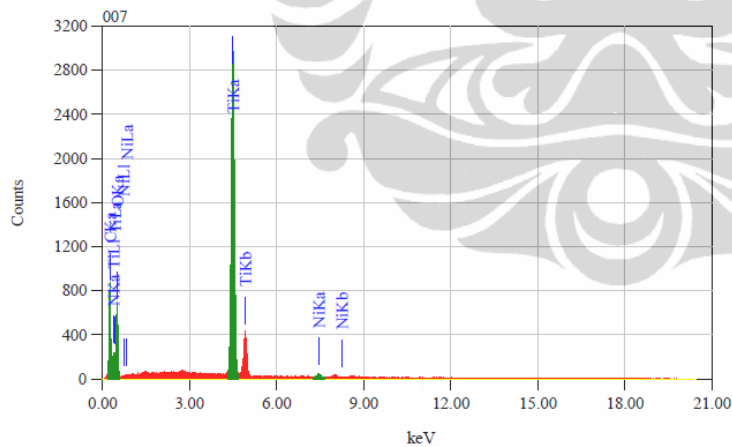
ZAF Method Standardless Quantitative Analysis
Fitting Coefficient : 0.2785

Element	(keV)	Mass%	Error%	Atom%	Compound	Mass%	Cation	K
C K	0.277	8.23	0.10	16.06				4.4297
N K	0.392	4.74	0.35	7.94				13.7283
O K	0.525	34.53	1.10	50.57				11.8058
Ti K	4.508	50.46	0.25	24.68				67.5583
Cu K	8.040	2.04	0.98	0.75				2.4779
Total		100.00		100.00				

B.8. Ni(5%)-N-TiO₂



Title : IMG1
Instrument : 6510 (LA)
Volt : 20.00 kV
Mag. : x 2,000
Date : 2010/12/15
Pixel : 512 x 384



Acquisition Parameter
Instrument : 6510 (LA)
Acc. Voltage : 20.0 kV
Probe Current: 1.00000 nA
PHA mode : T1
Real Time : 40.51 sec
Live Time : 30.00 sec
Dead Time : 25 %
Counting Rate: 2899 cps
Energy Range : 0 - 20 keV

ZAF Method Standardless Quantitative Analysis
Fitting Coefficient : 0.3063

Element	(keV)	Mass%	Error%	Atom%	Compound	Mass%	Cation	K
C K	0.277	15.22	0.08	25.40				9.5995
N K	0.392	8.02	0.42	11.47				19.0382
O K	0.525	37.25	0.91	46.67				14.8238
Ti K	4.508	38.66	0.22	16.17				55.3751
Ni K*	7.471	0.85	0.66	0.29				1.1634
Total		100.00		100.00				

ZAF Method Standardless Quantitative Analysis

Fitting Coefficient : 0.3113

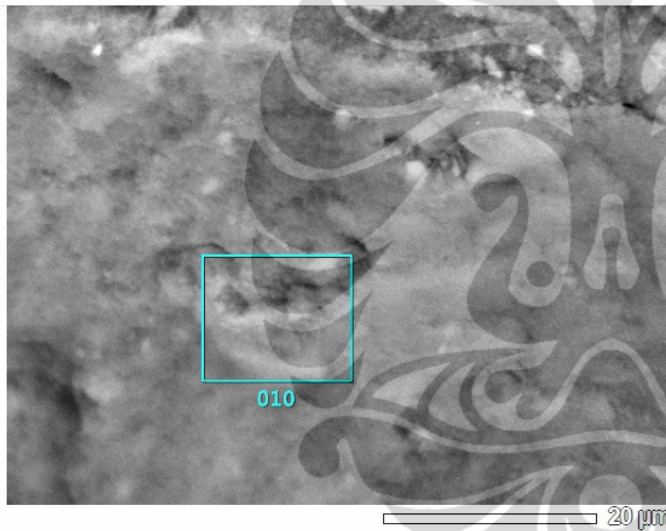
Element	(keV)	Mass%	Error%	Atom%	Compound	Mass%	Cation	K
C K	0.277	13.63	0.09	23.79				8.2769
N K*	0.392	6.68	0.44	10.01				16.5808
O K	0.525	35.94	1.06	47.12				13.5070
Ti K	4.508	42.84	0.25	18.76				60.4296
Ni K*	7.471	0.90	0.74	0.32				1.2057
Total		100.00		100.00				

ZAF Method Standardless Quantitative Analysis

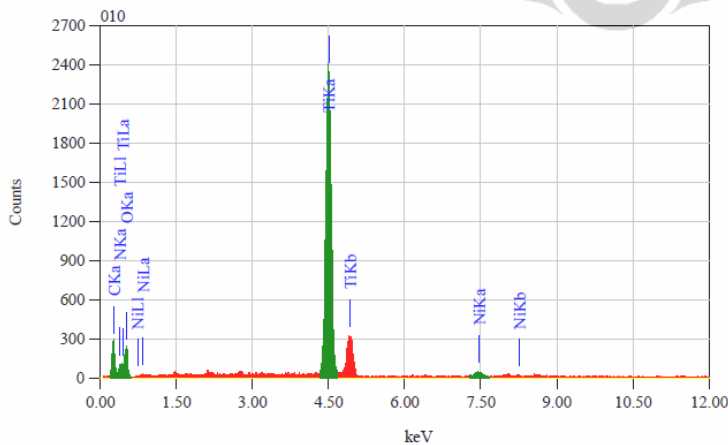
Fitting Coefficient : 0.2905

Element	(keV)	Mass%	Error%	Atom%	Compound	Mass%	Cation	K
C K	0.277	14.35	0.08	25.25				8.5810
N K	0.392	7.23	0.41	10.91				17.0960
O K	0.525	33.30	1.01	44.01				11.7849
Ti K	4.508	44.06	0.23	19.45				61.1397
Ni K*	7.471	1.06	0.68	0.38				1.3985
Total		100.00		100.00				

B.9. Ni(10%)-N-TiO₂



Title : IMG1
 Instrument : 6510 (LA)
 Volt : 20.00 kV
 Mag. : x 2,000
 Date : 2010/12/15
 Pixel : 512 x 384



Acquisition Parameter
 Instrument : 6510 (LA)
 Acc. Voltage : 20.0 kV
 Probe Current : 1.00000 nA
 PHA mode : T4
 Real Time : 36.65 sec
 Live Time : 30.00 sec
 Dead Time : 17 %
 Counting Rate : 1897 cps
 Energy Range : 0 - 20 keV

ZAF Method Standardless Quantitative Analysis
 Fitting Coefficient : 0.3198

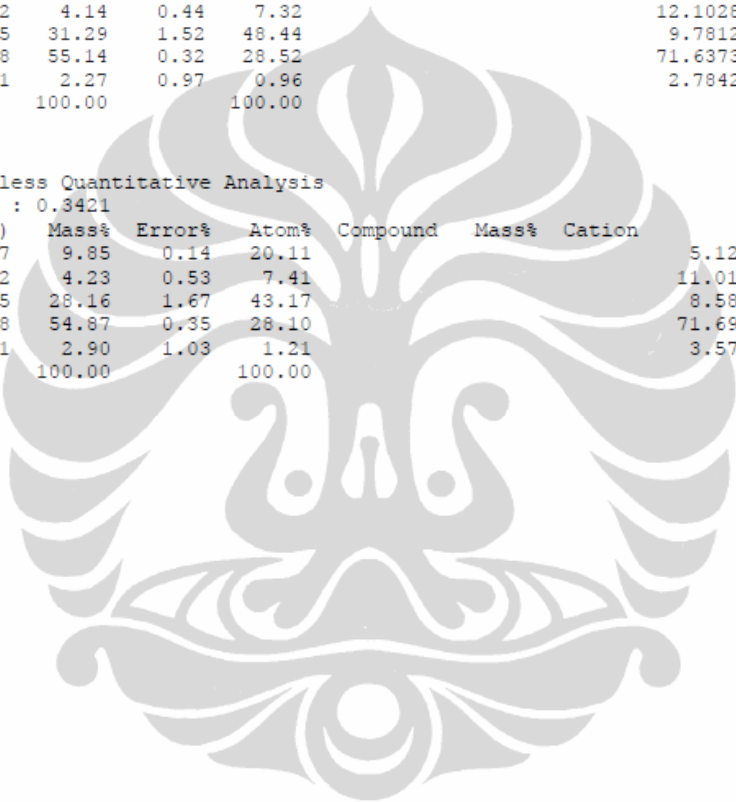
Element	(keV)	Mass%	Error%	Atom%	Compound	Mass%	Cation	K
C K	0.277	10.20	0.13	20.57				5.4092
N K	0.392	4.48	0.50	7.75				11.6236
O K	0.525	28.50	1.56	43.15				8.6628
Ti K	4.508	54.68	0.32	27.65				71.6741
Ni K	7.471	2.13	0.96	0.88				2.6303
Total		100.00		100.00				

ZAF Method Standardless Quantitative Analysis
 Fitting Coefficient : 0.3120

Element	(keV)	Mass%	Error%	Atom%	Compound	Mass%	Cation	K
C K	0.277	7.16	0.13	14.77				3.6946
N K	0.392	4.14	0.44	7.32				12.1028
O K	0.525	31.29	1.52	48.44				9.7812
Ti K	4.508	55.14	0.32	28.52				71.6373
Ni K	7.471	2.27	0.97	0.96				2.7842
Total		100.00		100.00				

ZAF Method Standardless Quantitative Analysis
 Fitting Coefficient : 0.3421

Element	(keV)	Mass%	Error%	Atom%	Compound	Mass%	Cation	K
C K	0.277	9.85	0.14	20.11				5.1251
N K	0.392	4.23	0.53	7.41				11.0132
O K	0.525	28.16	1.67	43.17				8.5898
Ti K	4.508	54.87	0.35	28.10				71.6965
Ni K	7.471	2.90	1.03	1.21				3.5753
Total		100.00		100.00				

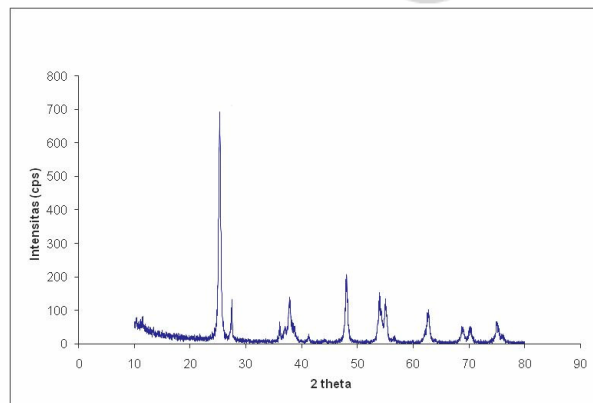


LAMPIRAN C. 1. DATA KARAKTERISASI XRD

XRD dilakukan menggunakan alat merk Shimadzu di PTBIN-BATAN, dengan kondisi:

* Diffr Type	:	PW1710
* Diffr Number	:	1
* Anode	:	Cu
* Labda Alpha1	:	1,5406
* Labda Alpha 2	:	1,54439
* Ratio Alpha 21	:	0,5
* Divergence Slit Automatic	:	12
* Receiving Slit	:	0,2
* Monochromator Used	:	YES
* Generator Voltage	:	40
* Tube Current	:	20
* Data Angle Range	:	10.01 - 79.9900
* Scan Step Size	:	0,02
* Scan Type	:	CONTINUOUS
* Scan Step Time	:	1

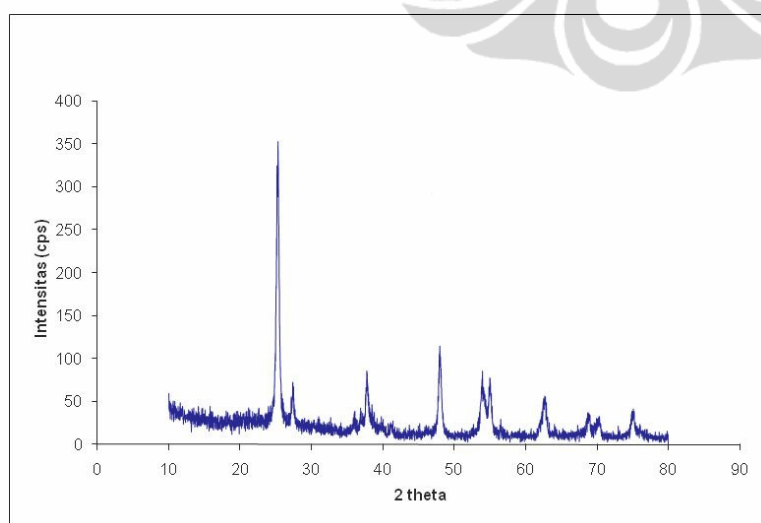
C.1.1.1. TiO₂ Degussa P25



PEAK: 47-pts/Quartic Filter, Threshold=2.0, Cutoff=1.0%, BG=1/5.0, Peak Top=Centroid Fit

2-Theta	d(A)	BG	Height	I%	Area	I%	FWHM
11,447	7,7238	21	48	7,2	4131	21,3	1,463
25,292	3,5184	11	668	100	19440	100	0,495
27,41	3,2512	10	102	15,3	3255	16,7	0,543
36,111	2,4852	5	52	7,8	2369	12,2	0,774
37,022	2,4262	5	44	6,6	8293	42,7	3,204
37,827	2,3764	5	129	19,3	7376	37,9	0,972
38,501	2,3363	5	48	7,2	5666	29,1	2,007
41,222	2,1882	5	18	2,7	701	3,6	0,662
48,023	1,8929	4	187	28	6279	32,3	0,571
53,977	1,6973	3	128	19,2	7686	39,5	1,021
55,04	1,6671	3	116	17,4	6897	35,5	1,011
62,688	1,4808	2	92	13,8	4479	23	0,828
68,858	1,3624	3	43	6,4	3110	16	1,23
70,221	1,3393	3	40	6	2932	15,1	1,246
74,993	1,2654	3	58	8,7	3315	17,1	0,972

C.1.2. Pt(1%)-N-TiO₂



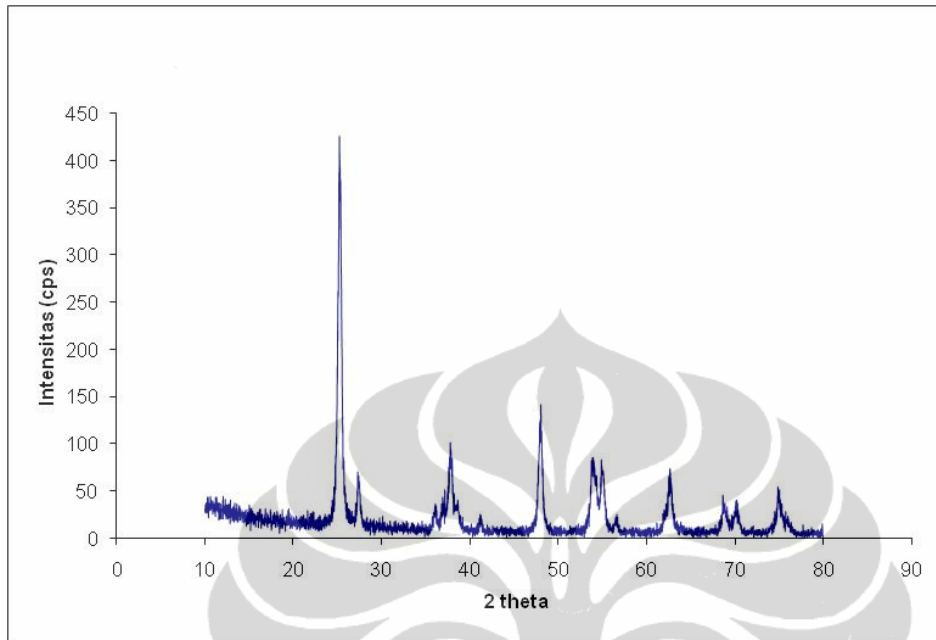
Peak Search Report (19 Peaks, Max P/N = 8.5)

[FILE1430.RD] Pt-N-TiO2 #1

PEAK: 47-pts/Quartic Filter, Threshold=2.0, Cutoff=1.0%, BG=1/5.0, Peak-Top=Centroid Fit

2-Theta	d(A)	BG	Height	I%	Area	I%	FWHM
22,634	3,9252	21	15	4,9	1376	12,6	1,559
24,033	3,6998	22	15	4,9	2667	24,5	3,023
25,272	3,5211	20	308	100	10879	100	0,6
27,37	3,2558	22	44	14,3	709	6,5	0,274
36,069	2,4881	9	20	6,5	3671	33,7	3,12
36,951	2,4307	10	23	7,5	3821	35,1	2,824
37,785	2,3789	10	65	21,1	5343	49,1	1,397
38,533	2,3345	10	23	7,5	3644	33,5	2,693
41,277	2,1854	9	13	4,2	946	8,7	1,237
47,99	1,8942	8	98	31,8	3735	34,3	0,648
53,962	1,6978	6	67	21,8	4575	42,1	1,161
54,986	1,6686	6	68	22,1	6332	58,2	1,583
56,513	1,627	6	14	4,5	880	8,1	1,069
62,659	1,4814	6	46	14,9	3270	30,1	1,208
64,128	1,451	7	10	3,2	1033	9,5	1,756
68,858	1,3624	6	27	8,8	2637	24,2	1,66
70,297	1,338	5	23	7,5	2163	19,9	1,599
73,274	1,2908	4	9	2,9	900	8,3	1,7
75,044	1,2647	4	31	10,1	2431	22,3	1,333

C.1.3. Cu(1%)-N-TiO₂



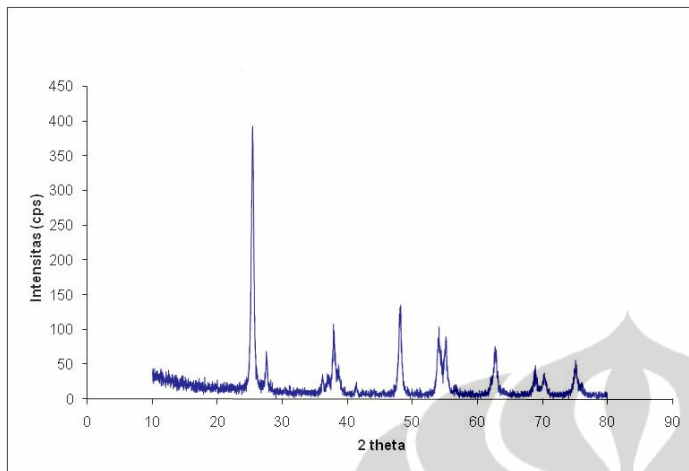
Peak Search Report (11 Peaks, Max P/N = 9.8)

[FILE1432.RD] Cu-N-TiO₂ #3

PEAK: 47-pts/Quartic Filter, Threshold=2.0, Cutoff=1.0%, BG=1/5.0, Peak-Top=Centroid Fit

2-Theta	d(A)	BG	Height	I%	Area	I%	FWHM
25,25	3,5242	12	392	100	12740	100	0,553
27,398	3,2526	11	51	13	2869	22,5	0,956
36,072	2,4879	8	22	5,6	2471	19,4	1,909
37,817	2,377	7	81	20,7	5601	44	1,176
47,992	1,8941	4	118	30,1	4907	38,5	0,707
53,967	1,6977	4	78	19,9	5895	46,3	1,285
54,952	1,6695	5	71	18,1	6343	49,8	1,519
62,634	1,482	4	61	15,6	3018	23,7	0,841
68,722	1,3648	4	33	8,4	3102	24,3	1,598
70,192	1,3397	5	31	7,9	2552	20	1,399
75,031	1,2649	4	44	11,2	2697	21,2	1,042

C.1.4. Cu(5%)-N-TiO₂



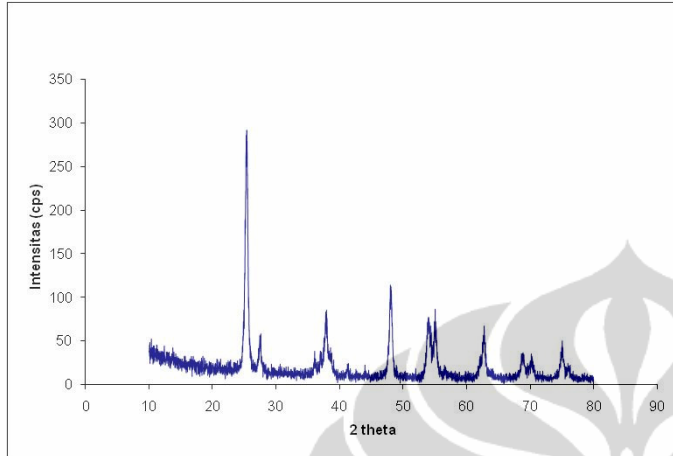
Peak Search Report (10 Peaks, Max P/N = 9.5)

[FILE1441.RD] C4-N-TiO₂ 5%

PEAK: 47-pts/Quartic Filter, Threshold=3.0, Cutoff=5.6%, BG=1/4.0, Peak-Top=Centroid Fit

2-Theta	d(A)	BG	Height	I%	Area	I%	FWHM
25,406	3,5029	11	374	100	11129	100	0,506
27,521	3,2383	10	55	14,7	2456	22,1	0,759
36,184	2,4804	6	26	7	2417	21,7	1,58
37,899	2,372	6	85	22,7	5079	45,6	1,016
38,586	2,3314	6	34	9,1	3560	32	1,78
48,132	1,8889	5	121	32,4	4534	40,7	0,637
54,078	1,6944	5	82	21,9	5483	49,3	1,137
55,122	1,6648	5	77	20,6	5001	44,9	1,104
62,735	1,4798	4	68	18,2	3334	30	0,834
75,123	1,2636	4	45	12	2833	25,5	1,07

C.1.5. Cu(10%)-N-TiO₂



Peak Search Report (15 Peaks, Max P/N = 8.1)

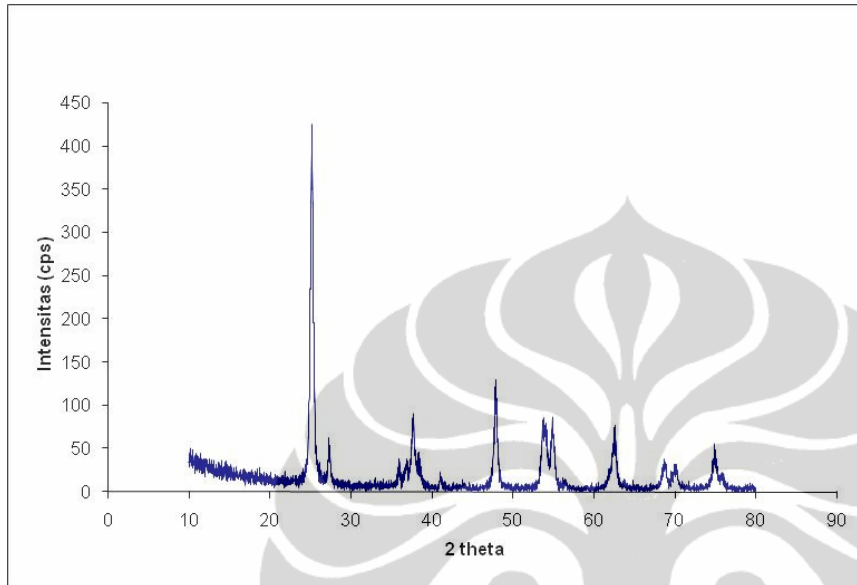
[FILE1442.RD] Cu(10%)N-TiO₂

PEAK: 47-pts/Quartic Filter, Threshold=3.0, Cutoff=5.6%, BG=1/4.0, Peak-Top=Centroid Fit

2-Theta	d(A)	BG	Height	I%	Area	I%	FWHM
25,36	3,5091	12	272	100	9253	100	0,578
27,464	3,2449	11	41	15,1	2162	23,4	0,896
36,109	2,4854	8	23	8,5	2186	23,6	1,616
37,095	2,4215	8	23	8,5	2669	28,8	1,973
37,878	2,3733	7	65	23,9	4458	48,2	1,166
38,66	2,3271	7	25	9,2	3873	41,9	2,634
48,074	1,8911	6	99	36,4	4046	43,7	0,695
54,048	1,6953	7	66	24,3	4788	51,7	1,233
55,036	1,6672	6	62	22,8	4775	51,6	1,309
62,231	1,4906	6	20	7,4	1750	18,9	1,487
62,759	1,4793	6	52	19,1	2603	28,1	0,851
68,927	1,3612	5	24	8,8	2564	27,7	1,816
70,304	1,3379	5	22	8,1	2491	26,9	1,925

75,054	1,2645	5	35	12,9	2099	22,7	1,02
76,05	1,2504	5	15	5,5	1297	14	1,47

C.1.6. Ni(5%)-N-TiO₂



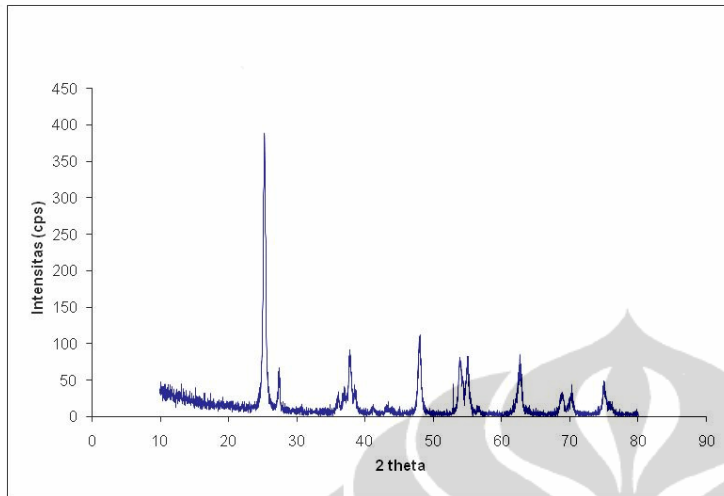
Peak Search Report (10 Peaks, Max P/N = 9.8)

[FILE1440.RD] N (5%)NTiO2

PEAK: 47-pts/Quartic Filter, Threshold=3.0, Cutoff=5.6%, BG=1/4.0, Peak-Top=Centroid Fit

2-Theta	d(A)	BG	Height	I%	Area	I%	FWHM
25,219	3,5284	8	389	100	11293	100	0,494
27,341	3,2592	7	47	12,1	2079	18,4	0,752
36,011	2,4919	5	24	6,2	1495	13,2	1,059
36,905	2,4336	4	28	7,2	3663	32,4	2,224
37,747	2,3812	4	82	21,1	4398	38,9	0,912
47,931	1,8964	3	114	29,3	3806	33,7	0,568
53,872	1,7004	3	77	19,8	6413	56,8	1,416
54,921	1,6704	2	79	20,3	4294	38	0,924
62,588	1,4829	2	57	14,7	3162	28	0,943
74,989	1,2655	2	40	10,3	2413	21,4	1,026

C.1.7. Ni(10%)-N-TiO₂



Peak Search Report (12 Peaks, Max P/N = 9.5)

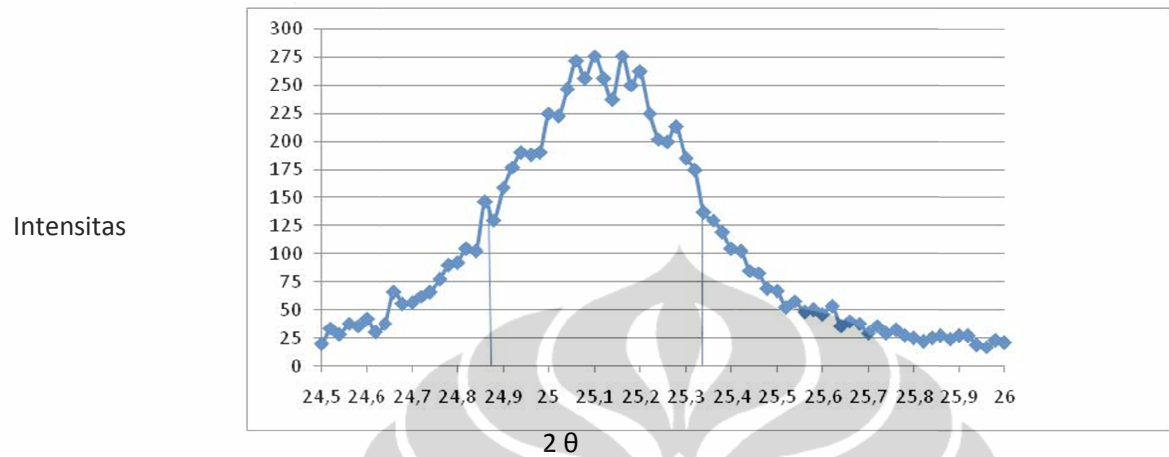
[FILE1439.RD] Ni(10%)NTiO₂

PEAK: 47-pts/Quartic Filter, Threshold=3.0, Cutoff=5.6%, BG=1/4.0, Peak-Top=Centroid Fit

2-Theta	d(A)	BG	Height	I%	Area	I%	FWHM
25,297	3,5178	8	369	100	11118	100	0,512
27,411	3,251	7	53	14,4	2096	18,9	0,672
36,102	2,4859	4	25	6,8	1822	16,4	1,239
37,069	2,4232	4	31	8,4	2931	26,4	1,607
37,831	2,3761	4	80	21,7	4704	42,3	1
38,45	2,3393	5	27	7,3	2759	24,8	1,737
48,011	1,8934	2	104	28,2	3711	33,4	0,607
53,953	1,698	2	75	20,3	4139	37,2	0,938
55,036	1,6672	2	74	20,1	5383	48,4	1,237
62,708	1,4804	1	69	18,7	3429	30,8	0,845
70,259	1,3386	3	26	7	1658	14,9	1,084
75,03	1,2649	2	39	10,6	2262	20,3	0,986

C.2. Cara Menghitung Ukuran Kristal

Contoh: Hasil XRD untuk Pt(1%)-N-TiO₂



Dari Persamaan Scherrer: $L = 0,9 \times \lambda / (\beta \cos \theta)$

Dimana :

FWHM dapat dilihat pada grafik di atas.

$$\beta = 0,5 \times \text{FWHM} = 0,44 / 57,29577451 = 0,00768$$

$$\theta = 12,6$$

Sehingga diperoleh:

$$L = (0,9 \times \lambda) / (\beta \cos \theta) = (0,89 \times 0,1540118) / (0,00768 \cos 12,6) \\ = 16,51 \text{ nm}$$

Menghitung fraksi rutile dengan rumus :

$$X = \left(1 + \frac{0,8I_A}{I_R} \right)^{-1}$$

LAMPIRAN D. DATA KARAKTERISASI UV-VIS DRS

Tabel D. 1. Data karakterisasi UV-Vis DRS untuk N-TiO₂, Pt(1%)-N-TiO₂, Cu-N-TiO₂ dan Ni-N-TiO₂

Panjang gelombang (nm)	% Reflektansi										
	N-TiO ₂	Pt(1 %)	Cu(1 %)	Cu(3 %)	Cu(5 %)	Cu(10 %)	Cu(20 %)	Ni(3 %)	Ni(5 %)	Ni(10 %)	Ni(20 %)
200	3,156	2,119	1,872	1,967	2,045	1,82	2,373	2,002	2,043	1,996	1,993
201	3,148	2,138	1,888	1,926	2,011	1,845	2,362	1,942	2,054	1,982	2,007
202	3,088	2,202	1,888	1,846	1,929	1,88	2,35	1,913	1,976	2	2,019
203	3,075	2,176	1,846	1,816	1,906	1,828	2,383	1,892	1,959	1,962	2,029
204	3,133	2,054	1,869	1,797	1,883	1,825	2,361	1,891	1,982	1,892	2,028
205	3,093	2,014	1,886	1,814	1,845	1,927	2,267	1,915	1,915	1,877	2,02
206	3,079	2,031	1,854	1,859	1,869	1,897	2,249	1,849	1,932	1,888	1,974
207	3,114	2,046	1,831	1,826	1,927	1,793	2,257	1,776	1,964	1,933	1,926
208	3,044	2,022	1,819	1,811	1,92	1,77	2,278	1,796	1,926	1,891	1,935
209	2,982	1,958	1,813	1,828	1,833	1,747	2,328	1,822	1,888	1,871	1,912
210	2,966	1,921	1,768	1,785	1,833	1,75	2,315	1,805	1,904	1,859	1,883
211	2,962	1,903	1,779	1,775	1,836	1,764	2,249	1,788	1,884	1,817	1,869
212	2,979	1,952	1,794	1,788	1,816	1,741	2,243	1,793	1,855	1,797	1,875
213	2,951	2,037	1,767	1,784	1,808	1,714	2,266	1,808	1,845	1,84	1,883
214	2,928	1,973	1,747	1,796	1,804	1,7	2,232	1,785	1,82	1,859	1,895
215	2,971	1,909	1,733	1,74	1,804	1,709	2,185	1,753	1,807	1,839	1,91
216	2,998	1,958	1,736	1,703	1,813	1,732	2,223	1,752	1,816	1,892	1,862
217	3,012	1,932	1,75	1,736	1,805	1,735	2,24	1,758	1,834	1,854	1,859
218	2,988	1,9	1,749	1,732	1,758	1,697	2,217	1,753	1,874	1,804	1,862
219	2,919	1,918	1,723	1,723	1,756	1,678	2,203	1,77	1,871	1,825	1,834
220	2,93	1,904	1,735	1,753	1,791	1,692	2,185	1,759	1,825	1,823	1,826
221	2,968	1,92	1,753	1,759	1,799	1,714	2,203	1,772	1,82	1,804	1,817
222	2,943	1,927	1,758	1,726	1,772	1,706	2,225	1,746	1,807	1,802	1,825

Panjang gelombang (nm)	% Reflektansi										
	N-TiO2	Pt(1 %)	Cu(1 %)	Cu(3 %)	Cu(5 %)	Cu(10%)	Cu(20%)	Ni(3 %)	Ni(5 %)	Ni(10 %)	Ni(20 %)
223	2,946	1,915	1,75	1,724	1,749	1,711	2,248	1,738	1,834	1,805	1,843
224	2,936	1,915	1,747	1,727	1,77	1,717	2,24	1,775	1,855	1,814	1,839
225	2,93	1,921	1,756	1,73	1,787	1,717	2,222	1,767	1,823	1,825	1,834
226	2,985	1,947	1,74	1,759	1,782	1,727	2,255	1,767	1,805	1,839	1,855
227	2,994	1,97	1,729	1,736	1,768	1,72	2,248	1,765	1,81	1,855	1,871
228	2,979	1,959	1,714	1,744	1,752	1,723	2,22	1,747	1,799	1,831	1,881
229	2,989	1,965	1,724	1,752	1,778	1,727	2,235	1,749	1,813	1,837	1,907
230	2,988	1,944	1,738	1,717	1,776	1,707	2,238	1,752	1,843	1,86	1,9
231	2,985	1,904	1,721	1,727	1,767	1,709	2,251	1,729	1,822	1,831	1,837
232	3,021	1,895	1,749	1,724	1,776	1,724	2,232	1,753	1,804	1,826	1,836
233	3,032	1,906	1,77	1,72	1,767	1,723	2,216	1,768	1,814	1,86	1,84
234	3,011	1,939	1,764	1,736	1,779	1,712	2,228	1,761	1,845	1,897	1,826
235	3,018	1,959	1,756	1,749	1,802	1,723	2,219	1,761	1,86	1,886	1,849
236	3,047	1,993	1,753	1,767	1,805	1,727	2,225	1,74	1,83	1,855	1,869
251	3,259	2,092	1,849	1,869	1,921	1,83	2,409	1,891	1,978	1,959	1,985
252	3,282	2,122	1,865	1,884	1,935	1,854	2,448	1,91	2,005	1,987	1,999
253	3,305	2,124	1,884	1,9	1,939	1,852	2,448	1,921	1,994	2,002	2,002
254	3,323	2,119	1,886	1,901	1,947	1,859	2,463	1,923	1,985	2,005	2,034
255	3,337	2,121	1,898	1,892	1,938	1,866	2,477	1,904	1,967	2,017	2,032
256	3,36	2,112	1,906	1,894	1,95	1,868	2,46	1,924	1,973	2,037	2,02
257	3,365	2,132	1,907	1,903	1,978	1,894	2,484	1,965	1,996	2,043	2,061
258	3,354	2,133	1,923	1,918	1,988	1,909	2,504	1,959	2,019	2,031	2,077
259	3,368	2,127	1,913	1,93	1,984	1,903	2,492	1,942	2,048	2,025	2,072
260	3,406	2,155	1,903	1,947	1,993	1,91	2,489	1,974	2,069	2,055	2,06
261	3,41	2,199	1,93	1,959	2,005	1,917	2,496	1,999	2,107	2,095	2,031
262	3,398	2,229	1,949	1,958	2	1,923	2,518	1,993	2,069	2,097	2,055

Panjang gelombang (nm)	% Reflektansi										
	N-TiO2	Pt(1 %)	Cu(1 %)	Cu(3 %)	Cu(5 %)	Cu(10%)	Cu(20%)	Ni(3 %)	Ni(5 %)	Ni(10 %)	Ni(20 %)
263	3,43	2,216	1,939	1,952	2,002	1,932	2,539	1,956	2,039	2,071	2,084
264	3,458	2,211	1,942	1,939	1,999	1,93	2,538	1,967	2,063	2,098	2,08
265	3,441	2,225	1,944	1,947	2,005	1,939	2,505	1,996	2,072	2,116	2,107
266	3,429	2,205	1,947	1,985	2,023	1,967	2,509	1,994	2,069	2,094	2,118
267	3,45	2,216	1,981	1,994	2,037	1,973	2,545	1,994	2,051	2,104	2,104
268	3,474	2,223	1,993	1,978	2,04	1,955	2,538	2,002	2,065	2,1	2,101
269	3,479	2,229	1,991	1,988	2,051	1,942	2,554	2,022	2,081	2,095	2,1
270	3,459	2,246	1,999	2	2,068	1,95	2,579	2,034	2,089	2,098	2,103
271	3,47	2,231	2	2,017	2,061	1,976	2,557	2,039	2,089	2,112	2,127
272	3,49	2,228	2,008	2,016	2,055	2,005	2,547	2,057	2,118	2,124	2,151
273	3,499	2,231	2,005	1,999	2,063	1,973	2,534	2,036	2,135	2,112	2,132
274	3,525	2,258	1,996	2,01	2,06	1,953	2,538	2,007	2,144	2,133	2,118
275	3,508	2,287	2,008	2,017	2,065	1,978	2,577	2,048	2,153	2,138	2,127
276	3,494	2,28	2,019	1,996	2,068	1,996	2,589	2,037	2,159	2,126	2,171
277	3,5	2,26	2,025	2,007	2,065	1,999	2,576	2,032	2,153	2,136	2,176
293	3,613	2,354	2,092	2,147	2,165	2,095	2,678	2,145	2,22	2,255	2,287
294	3,624	2,336	2,094	2,142	2,179	2,086	2,679	2,153	2,246	2,267	2,298
295	3,642	2,313	2,142	2,164	2,2	2,094	2,679	2,184	2,229	2,261	2,28
296	3,653	2,342	2,156	2,162	2,202	2,124	2,701	2,199	2,255	2,287	2,306
297	3,641	2,374	2,135	2,159	2,226	2,119	2,71	2,199	2,284	2,31	2,306
298	3,641	2,419	2,136	2,18	2,248	2,118	2,705	2,228	2,274	2,295	2,284
299	3,639	2,444	2,133	2,184	2,245	2,136	2,702	2,237	2,31	2,299	2,304
300	3,668	2,426	2,13	2,194	2,252	2,153	2,708	2,211	2,347	2,35	2,336
301	3,69	2,396	2,155	2,225	2,269	2,159	2,699	2,219	2,324	2,354	2,359
302	3,654	2,388	2,167	2,237	2,296	2,179	2,727	2,261	2,324	2,354	2,345
303	3,63	2,399	2,17	2,255	2,295	2,19	2,75	2,261	2,313	2,359	2,328

Panjang gelombang (nm)	% Reflektansi										
	N-TiO2	Pt(1 %)	Cu(1 %)	Cu(3%)	Cu(5%)	Cu(10 %)	Cu(20 %)	Ni(3 %)	Ni(5 %)	Ni(10 %)	Ni(20 %)
304	3,641	2,399	2,187	2,255	2,271	2,164	2,734	2,245	2,31	2,333	2,325
305	3,677	2,382	2,184	2,234	2,293	2,162	2,748	2,246	2,345	2,371	2,377
306	3,735	2,419	2,208	2,24	2,322	2,202	2,765	2,257	2,37	2,4	2,443
307	3,746	2,48	2,232	2,261	2,335	2,234	2,791	2,261	2,386	2,386	2,422
308	3,751	2,498	2,234	2,283	2,347	2,223	2,792	2,29	2,367	2,423	2,409
309	3,748	2,531	2,249	2,295	2,335	2,228	2,789	2,339	2,364	2,47	2,412
310	3,773	2,522	2,287	2,33	2,338	2,255	2,817	2,327	2,408	2,466	2,448
311	3,85	2,499	2,307	2,347	2,367	2,284	2,815	2,332	2,441	2,454	2,484
312	3,842	2,533	2,295	2,347	2,409	2,304	2,835	2,373	2,431	2,481	2,505
313	3,835	2,538	2,303	2,38	2,437	2,313	2,867	2,411	2,415	2,545	2,562
314	3,862	2,533	2,328	2,417	2,452	2,354	2,898	2,422	2,448	2,562	2,6
315	3,905	2,58	2,351	2,435	2,484	2,383	2,933	2,426	2,486	2,536	2,609
316	3,947	2,644	2,37	2,441	2,51	2,406	2,971	2,461	2,499	2,53	2,631
317	3,999	2,66	2,414	2,48	2,56	2,458	3,001	2,536	2,545	2,583	2,664
318	4,045	2,67	2,448	2,536	2,596	2,504	3,018	2,576	2,603	2,67	2,696
334	5,85	4,092	3,822	4,181	4,228	4,053	4,295	4,022	4,131	4,23	4,26
335	5,983	4,272	3,949	4,35	4,414	4,179	4,401	4,143	4,294	4,407	4,387
336	6,161	4,373	4,114	4,523	4,614	4,317	4,527	4,288	4,475	4,643	4,555
337	6,366	4,468	4,285	4,715	4,774	4,483	4,671	4,433	4,565	4,793	4,674
338	6,589	4,59	4,454	4,837	4,961	4,637	4,793	4,623	4,723	4,88	4,79
339	6,839	4,701	4,611	4,988	5,135	4,845	4,904	4,836	4,897	5,077	4,999
340	7,027	4,872	4,727	5,252	5,299	5,125	5,049	5,011	5,045	5,296	5,228
341	7,158	5,049	4,935	5,505	5,55	5,345	5,228	5,199	5,243	5,435	5,487
342	7,314	5,231	5,095	5,702	5,783	5,458	5,324	5,392	5,403	5,618	5,685
343	7,518	5,4	5,183	5,919	6,004	5,612	5,388	5,504	5,534	5,83	5,809
344	7,759	5,611	5,36	6,184	6,232	5,847	5,545	5,707	5,775	6,065	6,042

Panjang gelombang (nm)	% Reflektansi										
	N-TiO ₂	Pt(1%)	Cu(1%)	Cu(3%)	Cu(5%)	Cu(10%)	Cu(20%)	Ni(3%)	Ni(5%)	Ni(10%)	Ni(20%)
345	7,948	5,815	5,573	6,435	6,407	6,046	5,737	5,928	6,024	6,253	6,281
346	8,16	6,007	5,745	6,642	6,592	6,226	5,896	6,055	6,192	6,453	6,47
347	8,47	6,242	5,963	6,871	6,885	6,474	6,05	6,207	6,381	6,75	6,717
348	8,725	6,477	6,157	7,124	7,21	6,77	6,186	6,467	6,601	6,953	6,924
349	8,997	6,696	6,366	7,353	7,449	6,943	6,335	6,725	6,784	7,153	7,137
350	9,302	6,935	6,633	7,661	7,684	7,213	6,538	6,908	7,045	7,425	7,411
351	9,607	7,181	6,871	8,02	8,017	7,567	6,694	7,185	7,347	7,713	7,689
352	9,924	7,41	7,137	8,315	8,313	7,838	6,865	7,457	7,564	8,012	7,922
353	10,258	7,664	7,425	8,669	8,636	8,173	7,098	7,738	7,881	8,372	8,2
354	10,571	7,977	7,782	9,047	9,004	8,481	7,335	8,075	8,234	8,731	8,604
355	10,979	8,344	8,104	9,366	9,32	8,789	7,544	8,337	8,521	8,998	8,954
356	11,447	8,701	8,405	9,727	9,682	9,131	7,768	8,646	8,795	9,354	9,244
357	11,88	8,972	8,737	10,164	10,097	9,525	8,038	9,035	9,172	9,749	9,631
358	12,338	9,314	9,036	10,55	10,487	9,918	8,24	9,373	9,558	10,114	9,955
359	12,804	9,711	9,399	10,951	10,922	10,303	8,395	9,703	9,863	10,477	10,254
360	13,26	10,072	9,805	11,433	11,42	10,693	8,641	10,117	10,277	10,883	10,701
361	13,826	10,5	10,265	11,954	11,935	11,148	8,92	10,58	10,748	11,336	11,136
362	14,452	10,95	10,754	12,463	12,468	11,633	9,212	11,041	11,209	11,781	11,563
363	15,024	11,36	11,142	12,852	12,938	12,094	9,5	11,453	11,586	12,299	12,016
364	15,773	11,841	11,641	13,347	13,49	12,616	9,785	11,909	12,013	12,86	12,488
365	16,585	12,344	12,23	13,985	14,046	13,072	10,071	12,334	12,524	13,397	12,927
366	17,235	12,819	12,689	14,45	14,572	13,524	10,306	12,73	12,984	13,86	13,376
367	17,888	13,347	13,101	14,903	15,108	14,061	10,6	13,251	13,414	14,319	13,905
368	18,654	13,863	13,667	15,475	15,619	14,511	10,901	13,737	13,893	14,824	14,375
369	19,403	14,4	14,218	15,976	16,174	14,981	11,136	14,214	14,407	15,346	14,835
370	20,151	14,879	14,676	16,49	16,73	15,514	11,4	14,691	14,848	15,913	15,321

Panjang gelombang (nm)	% Reflektansi										
	N-TiO ₂	Pt(1%)	Cu(1%)	Cu(3%)	Cu(5%)	Cu(10%)	Cu(20%)	Ni(3%)	Ni(5%)	Ni(10%)	Ni(20%)
371	20,915	15,346	15,181	16,969	17,287	15,965	11,69	15,135	15,332	16,403	15,759
372	21,68	15,846	15,669	17,392	17,819	16,479	11,943	15,601	15,75	16,847	16,176
373	22,563	16,306	16,2	17,868	18,309	16,969	12,19	16,068	16,205	17,372	16,597
374	23,351	16,82	16,713	18,373	18,819	17,426	12,468	16,615	16,74	17,876	17,059
375	24,135	17,393	17,2	18,881	19,412	17,902	12,723	17,097	17,204	18,385	17,499
376	25,049	17,879	17,752	19,405	19,998	18,312	12,952	17,555	17,712	18,884	17,92
377	25,851	18,343	18,3	19,879	20,592	18,796	13,214	18,077	18,179	19,398	18,405
378	26,729	18,849	18,849	20,343	21,15	19,318	13,454	18,564	18,636	19,983	18,858
379	27,757	19,341	19,392	20,839	21,646	19,789	13,708	19,101	19,16	20,502	19,301
380	28,755	19,853	19,922	21,32	22,202	20,32	13,974	19,617	19,641	20,934	19,768
381	29,723	20,441	20,522	21,909	22,784	20,842	14,22	20,142	20,178	21,465	20,238
382	30,736	21,013	21,156	22,49	23,38	21,37	14,47	20,712	20,711	22,063	20,75
383	31,834	21,608	21,802	22,983	24,046	21,93	14,693	21,257	21,255	22,668	21,222
384	33,066	22,246	22,447	23,473	24,704	22,473	14,952	21,803	21,89	23,322	21,66
385	34,308	22,845	23,09	24,02	25,378	23,079	15,256	22,426	22,488	23,987	22,208
386	35,654	23,505	23,798	24,664	26,064	23,656	15,529	23,1	23,116	24,593	22,794
387	37,198	24,182	24,556	25,262	26,729	24,229	15,779	23,749	23,738	25,246	23,322
388	38,652	24,814	25,301	25,815	27,464	24,844	16,043	24,394	24,356	25,917	23,833
389	40,169	25,482	26,068	26,399	28,217	25,468	16,295	25,082	25,002	26,613	24,371
390	41,933	26,195	26,857	27,005	29,001	26,129	16,595	25,862	25,67	27,383	24,974
391	43,773	26,851	27,684	27,661	29,779	26,735	16,855	26,627	26,437	28,114	25,597
392	45,784	27,544	28,584	28,322	30,569	27,393	17,104	27,332	27,158	28,88	26,196
393	47,784	28,238	29,449	28,925	31,375	28,11	17,409	28,154	27,835	29,559	26,75
394	49,658	28,883	30,217	29,488	32,051	28,72	17,648	28,905	28,532	30,247	27,284
395	51,613	29,536	30,962	30,016	32,741	29,274	17,889	29,51	29,219	30,945	27,771
396	53,676	30,083	31,714	30,58	33,388	29,8	18,114	30,164	29,929	31,593	28,183

Panjang gelombang (nm)	% Reflektansi										
	N-TiO ₂	Pt(1%)	Cu(1%)	Cu(3%)	Cu(5%)	Cu(10%)	Cu(20%)	Ni(3%)	Ni(5%)	Ni(10%)	Ni(20%)
397	55,779	30,589	32,426	31,096	34,019	30,35	18,311	30,875	30,591	32,253	28,636
398	57,784	31,053	33,119	31,541	34,706	30,899	18,503	31,567	31,212	32,79	29,08
399	59,747	31,494	33,806	31,993	35,306	31,421	18,661	32,217	31,837	33,372	29,478
400	61,635	31,917	34,43	32,437	35,89	31,892	18,826	32,796	32,434	33,917	29,872
431	84,869	32,75	45,807	40,514	46,35	41,13	21,497	44,862	44,182	43,12	35,063
432	84,897	32,668	46,042	40,678	46,628	41,364	21,538	45,114	44,478	43,295	35,194
433	84,97	32,585	46,283	40,889	46,89	41,585	21,605	45,361	44,749	43,459	35,339
434	85,005	32,565	46,523	41,081	47,147	41,826	21,657	45,581	44,995	43,665	35,529
435	85,06	32,523	46,838	41,306	47,423	42,107	21,732	45,825	45,256	43,962	35,701
436	85,037	32,457	47,153	41,496	47,701	42,384	21,82	46,107	45,549	44,157	35,799
437	84,976	32,385	47,38	41,637	47,917	42,581	21,875	46,329	45,807	44,316	35,924
438	85,077	32,314	47,617	41,826	48,166	42,805	21,939	46,588	46,088	44,478	36,023
439	85,152	32,288	47,9	42,029	48,477	43,071	21,991	46,84	46,336	44,716	36,145
440	85,19	32,259	48,132	42,23	48,712	43,33	22,054	47,05	46,565	44,972	36,29
441	85,201	32,219	48,373	42,416	48,938	43,596	22,116	47,266	46,814	45,148	36,392
457	85,426	31,317	52,272	45,206	52,75	47,227	23,004	51,492	51,205	47,719	37,64
458	85,422	31,274	52,504	45,404	53,024	47,499	23,039	51,845	51,5	47,899	37,721
459	85,431	31,201	52,676	45,589	53,242	47,665	23,093	52,185	51,822	48,08	37,784
460	85,385	31,136	52,87	45,737	53,435	47,826	23,17	52,444	52,138	48,206	37,852
461	85,378	31,084	53,114	45,889	53,612	48,042	23,221	52,713	52,446	48,318	37,953
462	85,388	31,027	53,36	46,051	53,81	48,311	23,262	53,053	52,812	48,512	38,054
463	85,381	30,954	53,557	46,172	54,053	48,547	23,312	53,398	53,14	48,706	38,084
464	85,376	30,904	53,738	46,329	54,242	48,744	23,355	53,726	53,468	48,848	38,135
465	85,335	30,853	53,926	46,512	54,469	48,918	23,412	54,034	53,801	48,987	38,234
466	85,364	30,797	54,109	46,663	54,727	49,104	23,46	54,355	54,158	49,173	38,333
467	85,428	30,76	54,301	46,791	54,878	49,312	23,5	54,73	54,472	49,324	38,414

Panjang gelombang (nm)	% Reflektansi										
	N-TiO2	Pt(1%)	Cu(1%)	Cu(3%)	Cu(5%)	Cu(10%)	Cu(20%)	Ni(3%)	Ni(5%)	Ni(10%)	Ni(20%)
468	85,376	30,69	54,521	46,913	55,058	49,518	23,546	55,101	54,79	49,432	38,484
469	85,333	30,644	54,715	47,081	55,241	49,715	23,59	55,434	55,194	49,612	38,591
470	85,355	30,568	54,916	47,25	55,438	49,922	23,643	55,763	55,548	49,821	38,692
471	85,388	30,511	55,141	47,417	55,713	50,114	23,703	56,102	55,905	50,011	38,713
472	85,391	30,495	55,341	47,554	55,948	50,357	23,767	56,516	56,274	50,201	38,776
473	85,394	30,443	55,533	47,696	56,146	50,606	23,834	56,921	56,645	50,377	38,913
474	85,428	30,411	55,721	47,845	56,308	50,777	23,883	57,207	57,011	50,508	39,023
475	85,396	30,373	55,946	47,969	56,496	50,977	23,917	57,53	57,35	50,659	39,091
476	85,323	30,313	56,161	48,099	56,706	51,175	23,958	57,895	57,657	50,838	39,188
477	85,326	30,261	56,284	48,228	56,902	51,349	23,999	58,2	57,993	50,99	39,301
478	85,345	30,193	56,415	48,387	57,123	51,541	24,046	58,531	58,336	51,183	39,355
479	85,364	30,135	56,621	48,524	57,312	51,749	24,1	58,864	58,667	51,34	39,413
480	85,349	30,066	56,807	48,616	57,443	51,967	24,136	59,164	59,001	51,427	39,507
481	85,284	30,013	57,021	48,759	57,666	52,184	24,167	59,464	59,322	51,564	39,607
482	85,287	29,955	57,233	48,947	57,915	52,382	24,216	59,756	59,647	51,746	39,711
498	85,274	29,187	59,787	50,919	60,652	55,203	24,748	63,734	63,884	53,497	40,434
499	85,214	29,131	59,932	51,035	60,776	55,354	24,779	63,947	64,11	53,586	40,465
500	85,193	29,068	60,065	51,109	60,948	55,573	24,832	64,174	64,27	53,665	40,527
501	85,211	29,025	60,217	51,216	61,098	55,725	24,87	64,333	64,474	53,72	40,538
502	85,24	28,995	60,315	51,367	61,246	55,888	24,905	64,481	64,685	53,777	40,556
503	85,245	28,961	60,435	51,482	61,374	56,017	24,966	64,67	64,897	53,873	40,591
504	85,26	28,891	60,582	51,552	61,501	56,148	25,04	64,88	65,111	53,949	40,565
505	85,269	28,838	60,725	51,656	61,642	56,326	25,117	65,051	65,283	54,008	40,564
506	85,237	28,786	60,843	51,756	61,758	56,49	25,186	65,205	65,463	54,037	40,578
507	85,21	28,722	60,957	51,877	61,897	56,664	25,243	65,367	65,695	54,057	40,602
508	85,231	28,685	61,093	52,022	62,065	56,836	25,305	65,562	65,883	54,135	40,619

Panjang gelombang (nm)	% Reflektansi										
	N-TiO2	Pt(1%)	Cu(1%)	Cu(3%)	Cu(5%)	Cu(10%)	Cu(20%)	Ni(3%)	Ni(5%)	Ni(10%)	Ni(20%)
509	85,24	28,65	61,232	52,127	62,207	56,987	25,389	65,771	66,061	54,234	40,627
510	85,228	28,592	61,346	52,211	62,326	57,117	25,459	65,961	66,263	54,279	40,619
511	85,208	28,551	61,455	52,287	62,465	57,254	25,502	66,109	66,415	54,308	40,59
512	85,211	28,531	61,594	52,397	62,616	57,385	25,523	66,281	66,615	54,323	40,627
513	85,196	28,47	61,682	52,495	62,74	57,497	25,548	66,473	66,841	54,344	40,663
514	85,176	28,41	61,76	52,554	62,83	57,622	25,595	66,617	67,046	54,385	40,628
515	85,176	28,381	61,833	52,631	62,93	57,762	25,639	66,783	67,226	54,443	40,607
516	85,118	28,31	61,94	52,756	63,025	57,924	25,681	66,94	67,334	54,517	40,62
517	85,124	28,259	62,105	52,873	63,141	58,073	25,725	67,099	67,503	54,535	40,63
518	85,162	28,249	62,231	52,962	63,304	58,209	25,758	67,296	67,728	54,593	40,631
519	85,182	28,195	62,341	53,041	63,467	58,324	25,793	67,467	67,915	54,637	40,649
520	85,231	28,143	62,448	53,117	63,557	58,43	25,832	67,639	68,095	54,639	40,633
521	85,231	28,108	62,498	53,195	63,603	58,549	25,848	67,792	68,275	54,663	40,622
522	85,226	28,065	62,56	53,241	63,692	58,681	25,861	67,929	68,433	54,669	40,614
523	85,207	28,009	62,662	53,314	63,803	58,786	25,887	68,073	68,629	54,692	40,558
539	85,138	27,289	63,67	54,231	64,894	60,107	26,189	70,212	70,898	55,078	40,48
540	85,149	27,245	63,628	54,277	64,943	60,188	26,181	70,346	70,984	55,087	40,491
541	85,165	27,214	63,643	54,329	64,992	60,249	26,184	70,493	71,1	55,084	40,468
542	85,124	27,173	63,669	54,369	64,975	60,277	26,167	70,564	71,228	55,078	40,43
543	85,104	27,144	63,702	54,39	64,96	60,255	26,152	70,628	71,349	55,08	40,424
544	85,133	27,101	63,756	54,402	64,989	60,274	26,164	70,688	71,387	55,074	40,417
545	85,13	27,058	63,741	54,434	65,025	60,326	26,172	70,752	71,411	55,06	40,416
546	85,098	27,022	63,725	54,456	65,063	60,358	26,169	70,847	71,518	55,089	40,421
524	85,158	27,969	62,753	53,389	63,933	58,888	25,914	68,207	68,803	54,745	40,578
525	85,168	27,928	62,846	53,462	64,046	58,978	25,946	68,372	68,912	54,816	40,601
526	85,155	27,852	62,933	53,558	64,125	59,053	25,981	68,576	69,083	54,857	40,588

Panjang gelombang (nm)	% Reflektansi										
	N-TiO ₂	Pt(1%)	Cu(1%)	Cu(3%)	Cu(5%)	Cu(10%)	Cu(20%)	Ni(3%)	Ni(5%)	Ni(10%)	Ni(20%)
527	85,132	27,797	63,002	53,564	64,143	59,154	26,001	68,727	69,235	54,866	40,588
528	85,101	27,754	63,017	53,583	64,18	59,23	25,999	68,784	69,325	54,863	40,541
529	85,069	27,728	63,062	53,682	64,253	59,3	26,016	68,915	69,485	54,865	40,521
530	85,083	27,696	63,171	53,751	64,349	59,395	26,065	69,066	69,658	54,91	40,546
531	85,066	27,628	63,258	53,819	64,444	59,492	26,089	69,232	69,821	54,935	40,544
532	85,048	27,612	63,301	53,896	64,497	59,581	26,085	69,447	69,942	54,935	40,509
533	85,023	27,567	63,316	53,946	64,542	59,682	26,086	69,553	70,073	54,906	40,497
534	85,01	27,505	63,365	53,986	64,557	59,755	26,1	69,604	70,258	54,887	40,504
535	85,023	27,498	63,431	54,024	64,626	59,79	26,112	69,69	70,384	54,939	40,468
536	85,063	27,457	63,524	54,1	64,714	59,903	26,138	69,873	70,52	54,991	40,471
537	85,114	27,385	63,614	54,193	64,796	59,976	26,163	70,059	70,662	55,025	40,486
538	85,143	27,336	63,654	54,221	64,871	60,004	26,183	70,139	70,801	55,051	40,475
539	85,138	27,289	63,67	54,231	64,894	60,107	26,189	70,212	70,898	55,078	40,48
540	85,149	27,245	63,628	54,277	64,943	60,188	26,181	70,346	70,984	55,087	40,491
541	85,165	27,214	63,643	54,329	64,992	60,249	26,184	70,493	71,1	55,084	40,468
557	85,114	26,579	63,521	54,552	64,896	60,374	26,01	71,574	72,255	55,168	40,315
558	85,104	26,514	63,477	54,55	64,9	60,359	25,986	71,591	72,281	55,191	40,312
559	85,097	26,48	63,458	54,547	64,856	60,294	25,96	71,613	72,298	55,208	40,286
560	85,085	26,457	63,432	54,53	64,781	60,254	25,941	71,651	72,336	55,212	40,266
561	85,056	26,419	63,387	54,529	64,731	60,24	25,926	71,681	72,403	55,186	40,274
562	85,046	26,393	63,3	54,532	64,691	60,207	25,906	71,716	72,44	55,154	40,283
563	85,03	26,343	63,232	54,501	64,648	60,176	25,887	71,761	72,49	55,159	40,271
564	85,033	26,297	63,176	54,483	64,598	60,146	25,851	71,796	72,563	55,208	40,26
565	85,054	26,27	63,081	54,465	64,534	60,106	25,804	71,796	72,574	55,199	40,26
566	85,072	26,239	63,026	54,413	64,45	60,03	25,763	71,817	72,629	55,177	40,239
567	85,091	26,204	62,959	54,379	64,369	59,973	25,72	71,895	72,652	55,179	40,227

Panjang gelombang (nm)	% Reflektansi										
	N-TiO ₂	Pt(1%)	Cu(1%)	Cu(3%)	Cu(5%)	Cu(10%)	Cu(20%)	Ni(3%)	Ni(5%)	Ni(10%)	Ni(20%)
568	85,063	26,16	62,869	54,35	64,299	59,92	25,69	71,915	72,641	55,177	40,234
569	85,072	26,112	62,798	54,329	64,229	59,845	25,67	71,925	72,678	55,194	40,25
570	85,091	26,08	62,715	54,315	64,151	59,772	25,664	71,944	72,702	55,208	40,259
571	85,057	26,048	62,633	54,274	64,046	59,738	25,653	71,971	72,742	55,202	40,259
572	85,037	26,007	62,543	54,214	63,937	59,682	25,601	72,003	72,768	55,162	40,266
573	85,037	25,961	62,402	54,16	63,818	59,561	25,546	71,96	72,762	55,154	40,239
574	85,02	25,932	62,3	54,135	63,731	59,444	25,507	71,974	72,795	55,206	40,225
575	85,005	25,911	62,236	54,111	63,707	59,354	25,458	72,026	72,833	55,225	40,259
576	85,043	25,871	62,126	54,085	63,617	59,27	25,417	72,041	72,841	55,193	40,24
577	85,03	25,832	62,018	54,03	63,47	59,186	25,366	72,026	72,859	55,199	40,224
578	84,966	25,789	61,913	53,938	63,354	59,105	25,308	72,066	72,871	55,223	40,251
579	84,984	25,749	61,786	53,891	63,249	59,021	25,267	72,105	72,887	55,209	40,231
580	85,048	25,725	61,674	53,865	63,148	58,923	25,237	72,098	72,937	55,209	40,222
581	85,083	25,691	61,592	53,821	63,042	58,812	25,204	72,125	72,998	55,232	40,23
582	85,083	25,645	61,487	53,761	62,947	58,704	25,169	72,119	73,003	55,237	40,234
598	85,014	25,143	59,196	52,602	60,776	56,667	24,275	72,206	73,045	55,148	40,068
599	85,01	25,098	59,026	52,461	60,622	56,519	24,202	72,169	72,935	55,06	40,015
600	85,04	25,055	58,87	52,406	60,469	56,407	24,171	72,212	73,01	55,066	40,022
601	85,056	25,027	58,73	52,354	60,312	56,276	24,126	72,235	73,061	55,069	40,019
602	85,037	25,012	58,601	52,283	60,15	56,096	24,057	72,232	73,087	55,026	39,984
603	85,022	24,983	58,458	52,213	60,013	55,925	23,994	72,227	73,102	55,014	39,97
604	84,998	24,963	58,281	52,121	59,872	55,785	23,946	72,269	73,071	55,013	39,957
605	85,016	24,937	58,081	52,008	59,712	55,641	23,877	72,266	73,035	54,99	39,928
606	85,072	24,89	57,907	51,912	59,549	55,531	23,802	72,217	73,003	54,987	39,89
607	85,063	24,869	57,767	51,825	59,387	55,383	23,75	72,2	73,003	54,991	39,857
608	85,052	24,823	57,6	51,723	59,204	55,194	23,683	72,192	73,016	54,926	39,844

Panjang gelombang (nm)	% Reflektansi										
	N-TiO ₂	Pt(1%)	Cu(1%)	Cu(3%)	Cu(5%)	Cu(10%)	Cu(20%)	Ni(3%)	Ni(5%)	Ni(10%)	Ni(20%)
609	85,017	24,789	57,463	51,616	59,024	55,026	23,613	72,177	73,024	54,857	39,786
610	84,976	24,779	57,332	51,524	58,862	54,893	23,558	72,18	73,01	54,832	39,731
611	85,037	24,739	57,167	51,46	58,751	54,779	23,515	72,206	73,012	54,819	39,705
612	85,072	24,692	56,979	51,384	58,615	54,617	23,447	72,195	72,948	54,791	39,656
613	85,036	24,66	56,741	51,237	58,412	54,434	23,372	72,159	72,836	54,723	39,603
614	85,007	24,631	56,564	51,122	58,229	54,28	23,303	72,131	72,818	54,64	39,539
615	85,014	24,596	56,459	51,056	58,064	54,121	23,233	72,119	72,849	54,553	39,482
616	85,045	24,588	56,311	50,967	57,941	53,963	23,174	72,073	72,852	54,533	39,438
617	85,034	24,582	56,136	50,856	57,811	53,819	23,114	72,041	72,777	54,532	39,401
618	85,007	24,547	55,96	50,769	57,608	53,656	23,059	72,052	72,707	54,463	39,339
619	84,996	24,501	55,78	50,705	57,436	53,502	22,997	72,005	72,662	54,398	39,268
620	85,01	24,486	55,595	50,618	57,28	53,342	22,922	71,957	72,63	54,35	39,217
621	84,993	24,472	55,441	50,52	57,121	53,183	22,862	71,967	72,61	54,274	39,142
622	84,967	24,426	55,278	50,391	56,953	53,047	22,81	71,96	72,601	54,208	39,085
623	84,956	24,391	55,113	50,269	56,784	52,881	22,752	71,886	72,588	54,172	39,027
639	84,973	23,97	52,496	48,695	54,204	50,427	21,765	70,888	71,428	52,916	37,782
640	84,937	23,94	52,344	48,564	54,048	50,275	21,712	70,75	71,312	52,777	37,729
641	84,958	23,917	52,176	48,439	53,899	50,104	21,649	70,621	71,179	52,698	37,648
642	84,927	23,894	52,036	48,347	53,735	49,944	21,59	70,563	71,086	52,658	37,535
643	84,903	23,871	51,872	48,265	53,532	49,797	21,542	70,497	70,955	52,563	37,445
644	84,904	23,859	51,677	48,17	53,378	49,663	21,477	70,395	70,834	52,467	37,383
645	84,908	23,83	51,511	48,068	53,23	49,501	21,396	70,258	70,763	52,38	37,318
646	84,943	23,805	51,366	47,96	53,075	49,347	21,346	70,148	70,699	52,321	37,279
647	84,927	23,776	51,215	47,858	52,925	49,225	21,291	70,074	70,584	52,283	37,227
648	84,888	23,734	51,022	47,752	52,768	49,074	21,21	69,978	70,422	52,211	37,155
649	84,911	23,701	50,873	47,646	52,643	48,952	21,162	69,914	70,323	52,142	37,111

Panjang gelombang (nm)	% Reflektansi										
	N-TiO ₂	Pt(1%)	Cu(1%)	Cu(3%)	Cu(5%)	Cu(10%)	Cu(20%)	Ni(3%)	Ni(5%)	Ni(10%)	Ni(20%)
650	84,961	23,686	50,742	47,549	52,496	48,833	21,115	69,792	70,274	52,104	37,059
651	84,966	23,647	50,604	47,432	52,318	48,672	21,054	69,666	70,152	52,04	36,957
652	84,932	23,624	50,464	47,313	52,174	48,514	21,004	69,583	70,026	51,945	36,897
653	84,927	23,637	50,349	47,255	52,069	48,384	20,972	69,51	69,965	51,889	36,885
654	84,95	23,63	50,208	47,176	51,935	48,277	20,92	69,418	69,87	51,846	36,862
655	84,933	23,602	50,031	47,066	51,758	48,126	20,837	69,315	69,716	51,776	36,81
656	84,9	23,57	49,86	46,962	51,585	47,974	20,789	69,221	69,597	51,698	36,732
657	84,93	23,56	49,712	46,866	51,445	47,861	20,734	69,102	69,482	51,657	36,659
658	84,924	23,563	49,591	46,758	51,323	47,717	20,651	68,999	69,397	51,636	36,601
659	84,863	23,546	49,454	46,661	51,196	47,568	20,609	68,896	69,284	51,598	36,569
660	84,866	23,492	49,295	46,584	51,044	47,43	20,567	68,774	69,128	51,462	36,494
661	84,898	23,451	49,113	46,48	50,877	47,26	20,502	68,631	69,005	51,332	36,427
662	84,903	23,424	48,958	46,362	50,72	47,127	20,442	68,488	68,864	51,276	36,362
663	84,869	23,389	48,788	46,274	50,571	47,003	20,383	68,358	68,742	51,199	36,276
664	84,81	23,372	48,656	46,196	50,429	46,851	20,328	68,256	68,623	51,151	36,237
680	84,744	23,067	46,561	44,76	48,412	44,899	19,598	66,437	66,727	50,056	35,254
681	84,76	23,029	46,422	44,655	48,253	44,777	19,521	66,263	66,566	49,962	35,17
682	84,698	22,993	46,32	44,547	48,129	44,656	19,482	66,115	66,418	49,863	35,114
683	84,68	22,975	46,23	44,475	48,036	44,56	19,46	66,042	66,31	49,812	35,03
684	84,659	22,955	46,123	44,398	47,9	44,463	19,432	65,936	66,209	49,748	34,953
685	84,628	22,929	45,961	44,315	47,774	44,328	19,388	65,752	66,051	49,67	34,885
686	84,613	22,917	45,845	44,25	47,655	44,234	19,363	65,601	65,915	49,58	34,81
687	84,625	22,914	45,755	44,185	47,53	44,128	19,351	65,538	65,811	49,496	34,727
688	84,627	22,9	45,625	44,104	47,438	43,987	19,33	65,459	65,703	49,432	34,651
689	84,579	22,873	45,522	44,014	47,353	43,884	19,327	65,314	65,594	49,358	34,613
690	84,564	22,852	45,424	43,954	47,25	43,8	19,315	65,141	65,454	49,263	34,544

Panjang gelombang (nm)	% Reflektansi										
	N-TiO ₂	Pt(1%)	Cu(1%)	Cu(3%)	Cu(5%)	Cu(10%)	Cu(20%)	Ni(3%)	Ni(5%)	Ni(10%)	Ni(20%)
691	84,583	22,847	45,296	43,875	47,102	43,709	19,273	65,001	65,346	49,165	34,456
692	84,584	22,818	45,174	43,784	46,948	43,608	19,244	64,886	65,213	49,094	34,363
693	84,578	22,798	45,082	43,715	46,829	43,477	19,232	64,78	65,091	49,051	34,27
694	84,587	22,781	44,934	43,613	46,721	43,35	19,226	64,63	64,972	48,944	34,164
695	84,601	22,739	44,806	43,526	46,613	43,248	19,211	64,491	64,804	48,827	34,073
696	84,595	22,728	44,749	43,474	46,55	43,173	19,223	64,444	64,644	48,761	34,027
697	84,564	22,733	44,64	43,417	46,487	43,102	19,231	64,343	64,545	48,618	33,937
698	84,534	22,701	44,521	43,352	46,387	43,004	19,254	64,209	64,499	48,511	33,838
699	84,564	22,708	44,47	43,295	46,297	42,918	19,31	64,11	64,384	48,438	33,766
700	84,567	22,694	44,37	43,219	46,201	42,827	19,331	63,976	64,224	48,37	33,665
701	84,541	22,656	44,215	43,134	46,082	42,743	19,333	63,837	64,125	48,283	33,553
702	84,477	22,633	44,109	43,008	45,958	42,625	19,35	63,712	64,032	48,131	33,467
703	84,412	22,589	44,023	42,928	45,853	42,484	19,398	63,516	63,902	48,006	33,383
704	84,402	22,556	43,954	42,889	45,764	42,404	19,444	63,324	63,768	47,919	33,279
705	84,445	22,546	43,871	42,827	45,668	42,357	19,501	63,246	63,663	47,836	33,176
721	84,315	22,318	42,455	41,847	44,261	41,016	20,947	61,43	61,754	46,55	31,9
722	84,343	22,308	42,389	41,826	44,205	40,99	21,088	61,275	61,649	46,458	31,908
723	84,349	22,289	42,361	41,779	44,168	40,948	21,213	61,151	61,595	46,457	31,914
724	84,401	22,27	42,322	41,731	44,063	40,863	21,356	61,037	61,482	46,448	31,911
725	84,43	22,269	42,212	41,658	43,933	40,804	21,494	60,872	61,356	46,4	31,892
726	84,332	22,241	42,085	41,612	43,883	40,704	21,646	60,76	61,298	46,41	31,88
727	84,323	22,212	42,03	41,557	43,854	40,649	21,799	60,681	61,217	46,458	31,886
728	84,377	22,194	41,963	41,493	43,787	40,599	21,921	60,583	61,095	46,457	31,923
729	84,338	22,176	41,888	41,44	43,678	40,512	22,067	60,422	60,916	46,454	31,958
730	84,312	22,182	41,855	41,389	43,62	40,462	22,238	60,316	60,806	46,506	31,985
731	84,373	22,166	41,766	41,35	43,562	40,411	22,371	60,26	60,751	46,527	32,011

Panjang gelombang (nm)	% Reflektansi										
	N-TiO ₂	Pt(1%)	Cu(1%)	Cu(3%)	Cu(5%)	Cu(10%)	Cu(20%)	Ni(3%)	Ni(5%)	Ni(10%)	Ni(20%)
732	84,407	22,156	41,647	41,331	43,488	40,324	22,498	60,146	60,612	46,487	32,045
733	84,393	22,157	41,58	41,293	43,407	40,254	22,658	60,048	60,513	46,523	32,076
734	84,395	22,145	41,519	41,203	43,303	40,204	22,818	59,927	60,487	46,535	32,077
735	84,392	22,121	41,434	41,147	43,245	40,118	22,977	59,834	60,371	46,545	32,115
736	84,378	22,079	41,397	41,167	43,224	40,079	23,135	59,756	60,278	46,622	32,179
737	84,393	22,057	41,37	41,13	43,149	40,036	23,267	59,627	60,217	46,616	32,198
738	84,325	22,038	41,245	41,052	43,066	39,951	23,399	59,532	60,057	46,591	32,198
739	84,306	22,018	41,141	40,985	43,025	39,853	23,566	59,451	59,988	46,599	32,224
740	84,297	22,009	41,132	40,927	42,953	39,799	23,727	59,37	59,979	46,585	32,259
741	84,204	21,997	41,09	40,898	42,87	39,78	23,872	59,335	59,889	46,587	32,253
742	84,239	21,997	41,016	40,86	42,816	39,728	24,02	59,259	59,795	46,672	32,245
743	84,299	22,006	40,939	40,849	42,787	39,671	24,149	59,149	59,744	46,709	32,3
744	84,21	21,988	40,862	40,823	42,732	39,609	24,269	59,068	59,692	46,635	32,361
745	84,224	22,006	40,823	40,765	42,612	39,554	24,399	59,076	59,659	46,622	32,352
746	84,326	21,988	40,814	40,709	42,551	39,507	24,542	59,099	59,682	46,674	32,37
762	84,192	21,747	39,944	40,208	41,754	38,771	26,591	58,946	59,618	46,898	32,684
763	84,135	21,721	39,926	40,244	41,711	38,756	26,727	58,992	59,662	46,967	32,738
764	84,146	21,704	39,874	40,233	41,644	38,655	26,878	58,966	59,648	46,974	32,739
765	84,172	21,704	39,796	40,157	41,592	38,606	26,984	58,92	59,674	47,008	32,777
766	84,097	21,729	39,746	40,143	41,563	38,577	27,069	58,888	59,685	47,064	32,816
767	84,143	21,741	39,688	40,126	41,553	38,57	27,193	58,888	59,631	47,064	32,835
768	84,261	21,754	39,624	40,1	41,513	38,55	27,304	58,865	59,578	47,014	32,87
769	84,207	21,733	39,655	40,118	41,464	38,483	27,422	58,817	59,572	47,023	32,87
770	84,09	21,706	39,656	40,086	41,463	38,446	27,56	58,752	59,543	47,063	32,919
771	84,004	21,719	39,575	40,036	41,405	38,382	27,647	58,725	59,535	47,122	32,965
772	84,048	21,698	39,511	39,993	41,293	38,376	27,67	58,727	59,587	47,147	32,983

Panjang gelombang (nm)	% Reflektansi										
	N-TiO ₂	Pt(1%)	Cu(1%)	Cu(3%)	Cu(5%)	Cu(10%)	Cu(20%)	Ni(3%)	Ni(5%)	Ni(10%)	Ni(20%)
773	84,116	21,651	39,491	39,938	41,263	38,365	27,751	58,745	59,506	47,108	33,011
774	84,099	21,637	39,432	39,941	41,322	38,374	27,887	58,734	59,413	47,144	33,003
775	84,045	21,652	39,398	39,955	41,309	38,356	27,992	58,719	59,454	47,217	33,009
776	84,059	21,617	39,391	39,987	41,248	38,295	28,085	58,693	59,512	47,206	33,012
777	84,039	21,577	39,308	39,98	41,17	38,249	28,175	58,6	59,451	47,205	33,058
778	83,983	21,567	39,273	39,954	41,104	38,213	28,239	58,537	59,418	47,194	33,138
779	83,998	21,602	39,281	39,948	41,147	38,208	28,304	58,519	59,456	47,227	33,151
780	83,987	21,648	39,246	39,89	41,15	38,15	28,362	58,508	59,343	47,316	33,128
781	84,044	21,599	39,182	39,85	41,061	38,086	28,436	58,446	59,28	47,311	33,125
782	84,093	21,544	39,079	39,83	40,982	38,057	28,5	58,377	59,349	47,281	33,124
783	84,109	21,542	39,02	39,832	40,927	38,065	28,59	58,383	59,314	47,218	33,151
784	84,09	21,527	39,026	39,783	40,915	38,04	28,703	58,401	59,29	47,211	33,235
785	84,053	21,532	39,041	39,706	40,857	38,013	28,737	58,405	59,268	47,206	33,253
786	84,004	21,547	38,985	39,705	40,784	37,949	28,77	58,411	59,131	47,162	33,22
787	83,949	21,504	38,904	39,706	40,756	37,912	28,841	58,293	59,076	47,163	33,168