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APPENDICES

APPENDIX A
THE CALCINATION CONDITIONS OF THE PREPARED CATALYSTS AND CONTROLLER SETPOINTS

Temperature controller parameter:

Alarm 1, (A1)	=	0
Alarm 2, (A2)	=	0
Xp %, (Pb)	=	2
T integral [sec], (τ_I)	=	Off
T derivative [sec], (τ_D)	=	Off
Approach, (Ap)	=	1.0
Cycle time [sec], (Hc)	=	10
Maximum power [heat], (H_L)	=	100
Set point [celcius]	=	550

Conditions of calcination:

Air flow rate = 30 ml min^{-1}

Rate of temperature program = 10°C min^{-1}

APPEENDIX B
CALCULATION OF CRYSTALLITE SIZE

Calculation of crystallite size by Sherrer equation

Crystallite size was calculated from the half-height width of the 101 diffraction peak of anatase using the Sherrer equation. The value of the shape factor, K was taken to be 0.9 and KCl was used to be internal standard.

From Sherrer equation:

$$t = \frac{0.9\lambda}{B \cos \theta_B} \qquad \text{(B.1)}$$

Where: t = crystallite size

K = shape factor = 0.9

λ = X-ray wavelength, Cu Kα: λ = 1.5418 A°

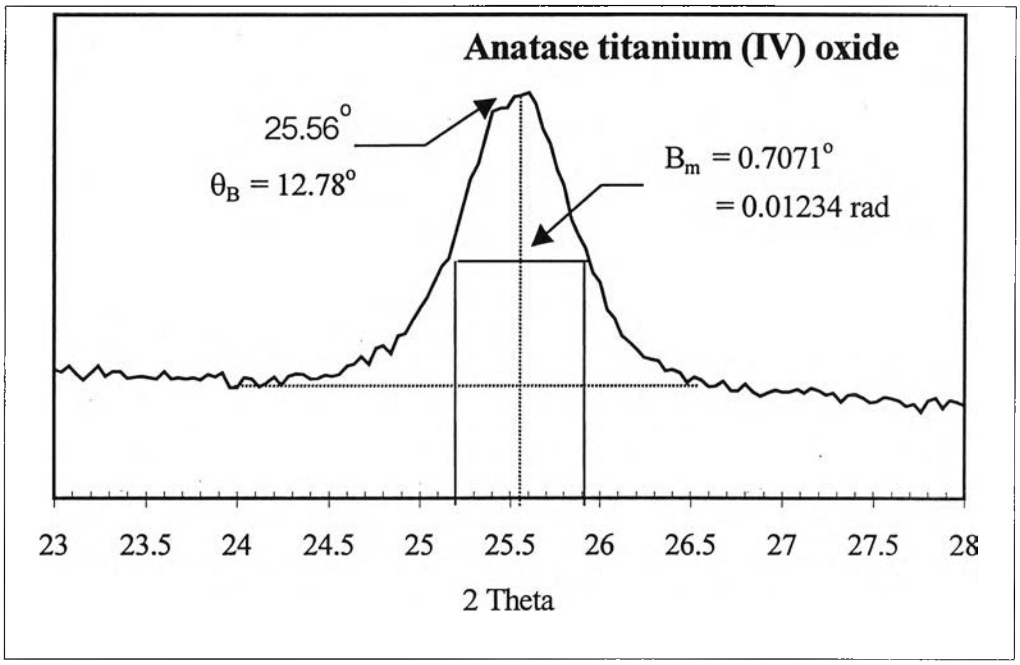
θ_B = the Bragg angle

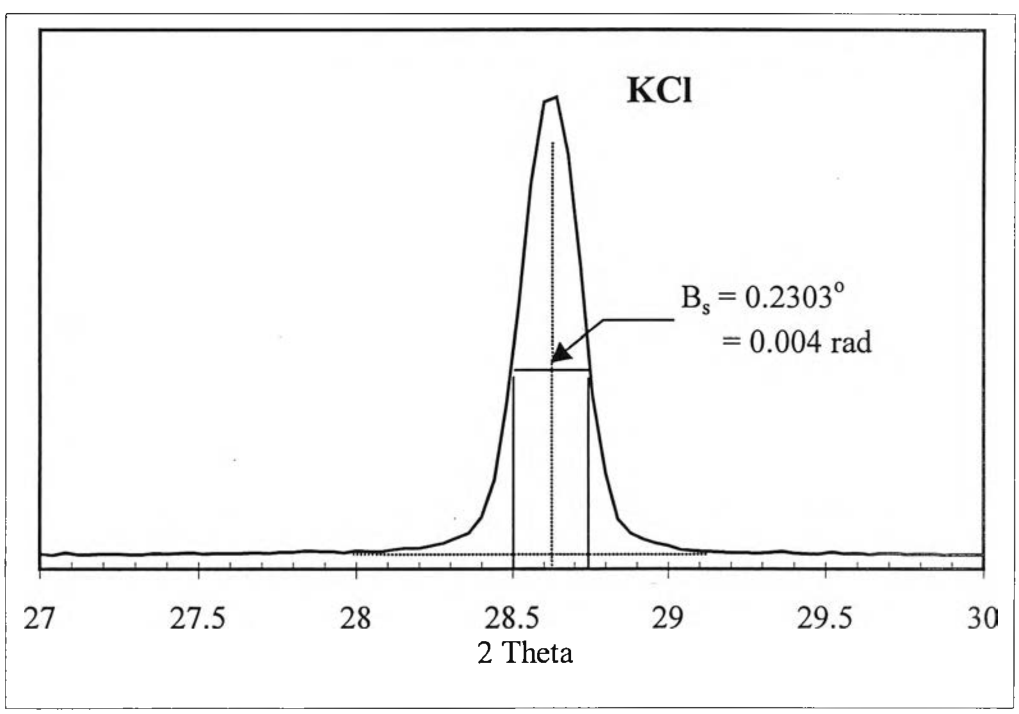
B^2 = $B^2_M - B^2_S$

B_M = the measured peak width in radians at half peak height.

B_S = the corresponding width of a standard material

Example: The crystallite size of pure anatase titanium (IV) oxide prepared in 1,4 butanediol is calculated as follow:





From $B^2 = B^2_M - B^2_S$

$= 0.01234^2 - 0.00402^2 = 0.00013$

$B = 0.0117$

$\theta_B = 12.78^{o}$

$\lambda = 1.5418\ A^{o}$

So, $t = (0.9 \times 1.5418) / (0.0117 \times \cos 12.78)$

$= 121.6\ A^{o} = 12.2\ nm$

APPENDIX C
CRYATAL SIZE MEASUREMENT FORM TEM PHOTOGRAPH

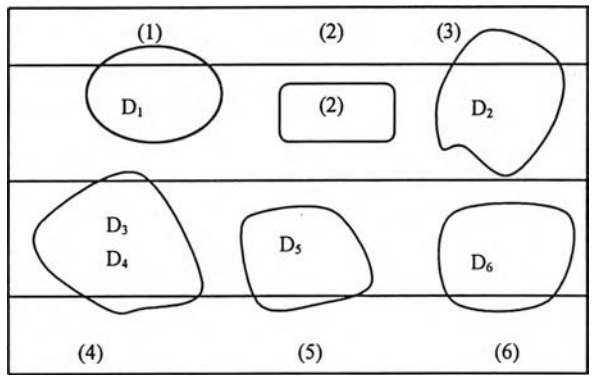


Figure C1 demonstrates how crystal diameter is determined

1. First grid lines at a determined interval were drawn on the photo.
2. Measure crystal diameter along the grid line that pass through the crystal.
3. Calculate the average diameter from the equation

$$D_{ave} = \frac{1}{N}\sum_{i=1}^{N} D_i$$

Where D_{ave} = Average diameter

N = number of intersection between grid line and particles

D_i = length of particle along the grid line intersection

For example, from the figure C1

$$D_{ave} = \frac{1}{6}(D_1 + D_2 + D_3 + D_4 + D_5 + D_6)$$

Note for particle number (4), 2 intersection exist hence there are 2 data used to calculate in this formula. For particle number (2), there is no intersection hence there is no data used to calculate.

In practices, each TEM photo is enlarged before measurement due to easy to measure.

APPENDIX D
GAS CHROMATOGRAPH

D1 Operating condition

Flame ionization detector gas chromatograph, model 14A was used to analyze the concentrations of oxygenated compounds, acetone and 2-propanol

Gas chromatograph with the thermal conductivity detector, model 8A was used to analyze the concentrations of CO_2 by using Porapak QS.

The operating conditions for gas chromatograph are described below:

GC model	**Shimadzu GC-14A**	**Shimadzu GC-8A**
Detector	FID	TCD
Column	Capillary	Porapak QS
Nitrogen flow rate	25 ml/min	-
Helium flow rate	-	25 ml/min
Column temperature		
- initial	40°C	80°C
- final	140°C	80°C
Injector temperature	150°C	130°C
Detector temperature	150°C	130°C

D2 Calibration curve

The calibration curves of 2-propanol, acetone, methanol and carbondioxide are illustrated in the following figures.

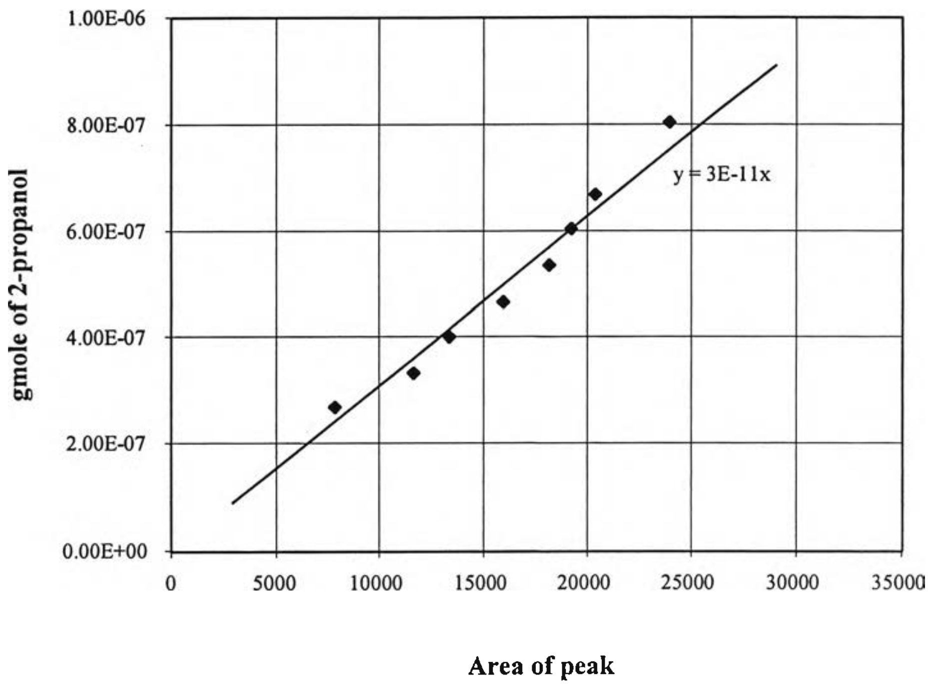


Figure D1 The calibration curve of 2-propanol

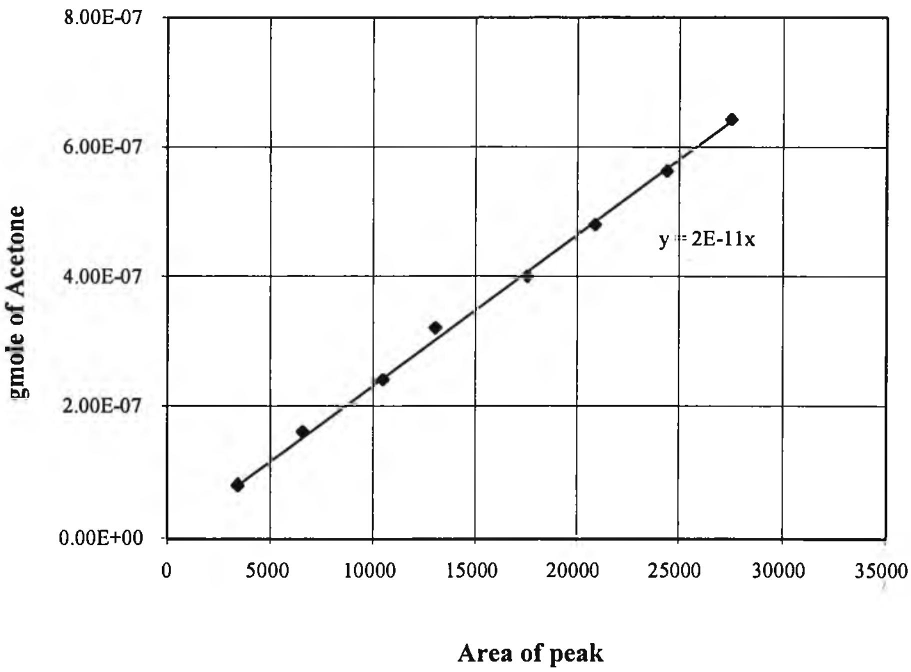


Figure D2 The calibration curve of acetone

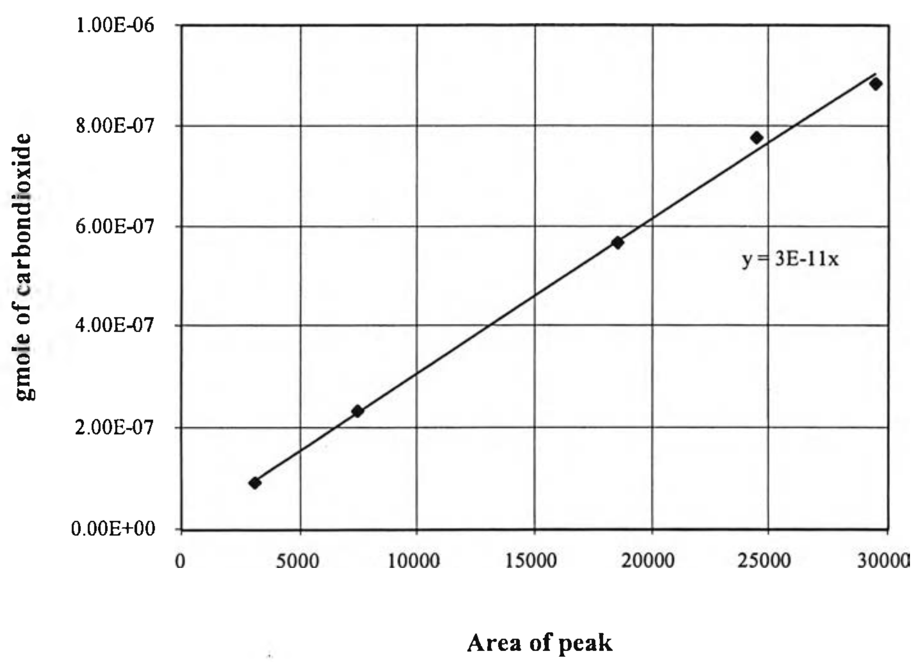


Figure D3 The calibration curve of carbondioxide

APPENDIX E
DATA OF EXPERIMENTS

Table E1 Data of figures 5.9-5.14

Time (min)	% 2-propanol conversion of					
	TiO2(5:0)	TiO2(4:1)	TiO2(3:2)	TiO2(2:3)	TiO2(1:4)	TiO2(0:5)
0	0	0	0	0	0	0
30	0	0	0	0	0	0
60	0	0	0	0	0	0
90	0	0	0	0	0	0
120	0	0	0	0	0	0
150	0	0	0	0	0	0
180	20.41	0.35	21.03	2.84	0	0
210	22.83	14.49	31.56	14.27	0	13.91
240	25.47	17.24	37.33	11.03	1.3	11.86
270	22.33	21.29	28.76	10.89	0.56	13.76
300	20.28	31.27	29.92	8.61	9.23	8.94
330	20.63	35.31	33.75	14.56	1.1	11.23
360	24.91	33.61	36.33	9.19	8.56	16.74
390	20.03	29.16	34.12	7.99	1.62	7.07
420	19.85	26.96	28.81	15.66	4.65	10.09
450	19.98	20.47	30.56	6.57	6.23	6.66
480	22.08	25.07	35.46	10.89	12.98	6.32
510	22.45	19.38	31.15	6.14	7.54	11.56
540	25.1	21.09	26.59	10.64	9.73	14.06
570	25.7	20.43	27.7	8.12	11.83	11.09
600	22.6	20.03	32.64	9.05	10.62	9.69

APPENDIX F
NOTATION

A	= Electron acceptor
BET	= Brunauer-Emmett-Teller
D	= Electron donor
e^-	= Electron
FTIR	= Fourier Transform Infrared Spectroscopy
GC	= Gas Chromatrograph
h^+	= Proton
MB	= Methylene Blue
STREC	= Scientific and Technological Research Equipment Center
TCE	= Trichloroethylene
TEM	= Transmission Electron Microscope
THyCA	= Transfer Hydrolytic Crystallization in Alcohols
TiO_2	= Titanium (IV) oxide
TNB	= Titanium normal butoxide
TPD	= Temperature Programmed Desorption
TTB	= Titanium (IV) tetra-tert butoxide
UV	= Ultraviolet light
UV-Vis	= Ultraviolet- Visible light
VOC	= Volatile Organic Compound
XRD	= X-Ray Diffraction
XPS	= X-Ray Photoeletron Microscopy

VITA

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