

TiO₂

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Photocatalytic Degradation of Methylene Blue by the Combustion Synthesized TiO₂ Nanoparticles

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Key Words: Combustion Synthesis (), TiO₂ Nanoparticles (TiO₂), Flame Temperature (), Particle Characteristics (), Methylene Blue ()

Abstract

In this work, combustion-synthesized TiO₂ nanoparticles were used for the photocatalytic degradation of methylene blue with UV light irradiation. Also the results were compared with those of commercial TiO₂ nanoparticles (Degussa, P-25). Particle characteristics of the two were analyzed thru the SEM, TEM, and XRD. In spite of the lower specific surface area than that of P-25, the TiO₂ nanoparticles formed in this study showed the relatively good ability to degrade the concentration of the organics.

(rutile), (amorphous) 3가
가 , ,
TiO₂
가
1. 가 가
TiO₂ (photocatalytic activity)
, 가 가
(1) 가 가
가 (3)
(2) TiO₂
TiO , 가
(4-6)
TTIP(titanium tetraisopropoxide) 가
TiCl₄ (titanium tetrachloride)가 ,
TiO (anatase), (7)

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TiO 가

가

Yang⁽⁸⁾ TTIP TiO₂ P-25 가 SEM (scanning electron microscope) XRD (x-ray diffraction) (spectrophotometer)

가 900~1,430°C TiO₂ 100% 가

1,500~1,570°C 가 TiO₂ 가

가 TiO₂ 가 TiO (methlene blue)가

가 TiO₂ 가

2. TTIP (Ar), (H₂), (N₂ O₂) (MFCs) 가 UV TTIP

Fig. 1

Sivalingam⁽⁹⁾ (glycine) combustion method) titanyl nitrate (solution) 8~10nm 50~200ppm 127 μ m R- (Pt/Pt-13%Rd) A/D (HP 34970A)

TiCl₄ (LPG) 20nm TiO₂ 가 TTIP가 가 (hydrolysis)

UV 가

Jang⁽⁷⁾ TiCl₄ 가 30mm \times 30mm 150mm 가 (C₁₆H₁₈ClN₃S) 2.0 \times 10⁶ μ g/m³ 가 TiO₂ P-25 가 80mg 가 (MS-300)가 TTIP UV

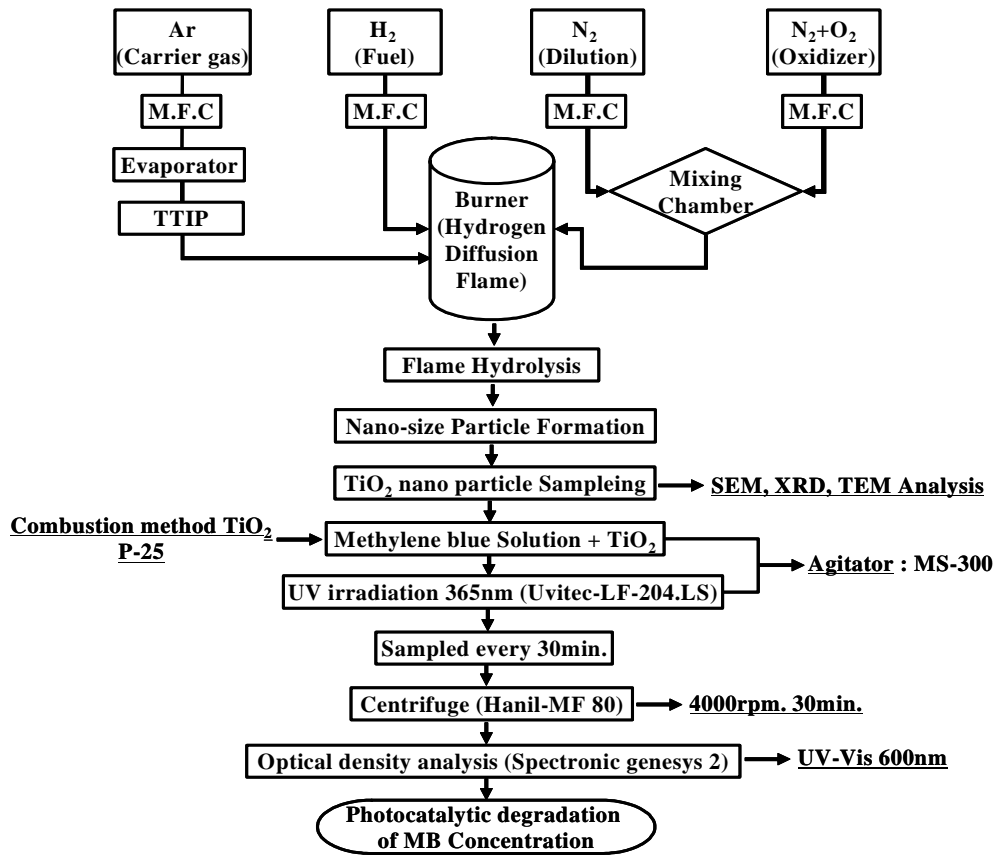


Fig. 1 Experimental procedure

UV	(Uvitec, LF-204.LS)	365nm	30	(Hanil, MF80)	4000rpm	(Spectronic, Genesys 2)	600nm	TiO ₂
Table 1								

Table 1 Experimental conditions

Gas	Flowrate (Liters/min.)					TTIP
	Ar	H ₂	N ₂	N ₂	O ₂	
Function	TTIP	Fuel	Dilution	Oxidizer		Evaporation temperature
Flow Rate	0.5	3.3	0.0	8.9	3.8	80°C
Tube Inner diameter	3.87 mm	10.22 mm	16.57 mm	22.10 mm		

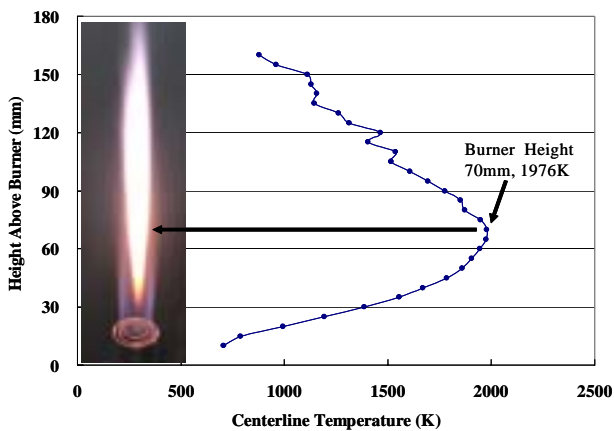


Fig. 2 A photo of hydrogen flame synthesizing TiO_2 nanoparticles and centerline temperature distribution

70mm 1976K

Fig. 3

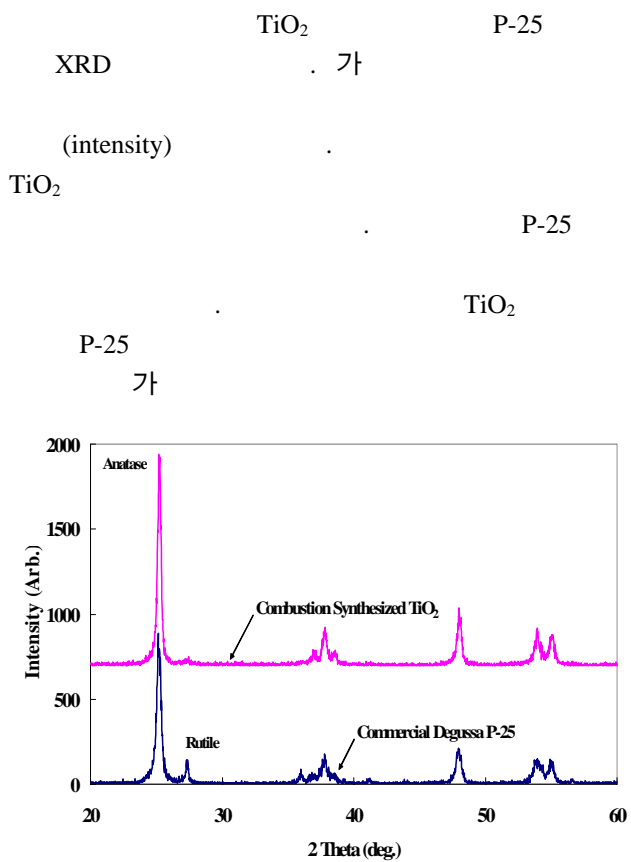


Fig. 3 X-ray diffraction patterns of synthesized combustion-synthesized TiO_2 nanoparticles and P-25 particles

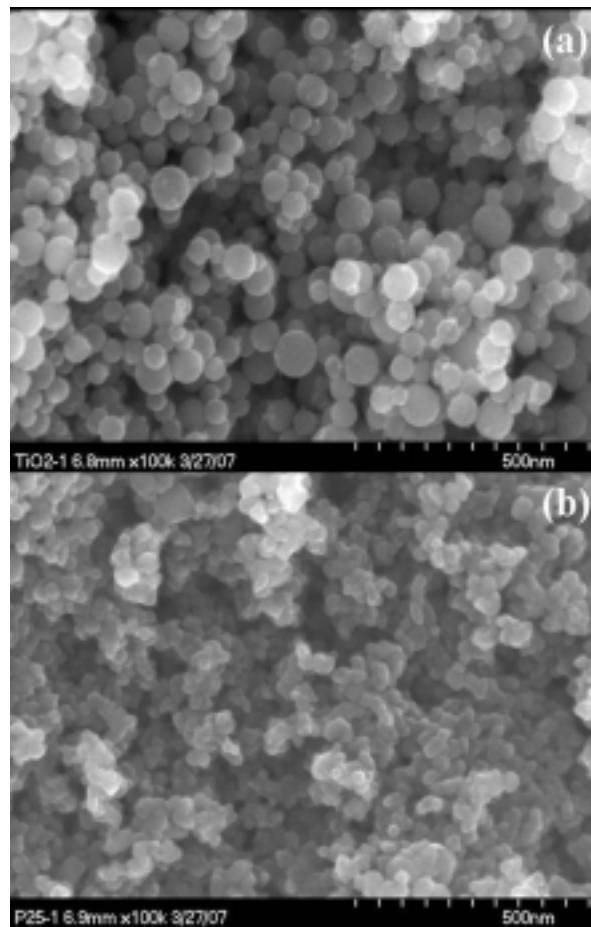
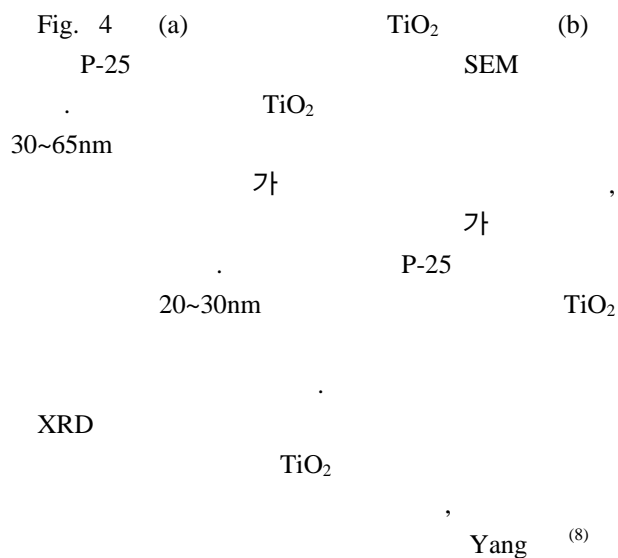


Fig. 4 SEM images of combustion-synthesized TiO_2 nanoparticles and P-25 particles

3.2
 가
 가
 Table 2
 TiO₂
 P-25
 Robert (11)
 XRD

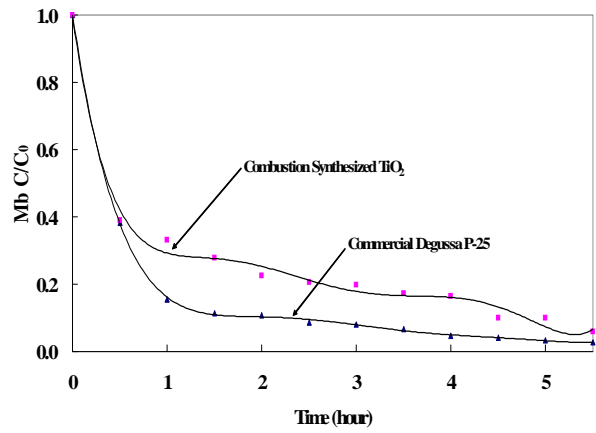


Fig. 5 Normalized degradation of MB concentrations with time

TiO₂ 가 P-25
 가 2
 Fig. 5
 TiO₂ P-25
 가
 (normalized
 concentration) C/C₀
 TiO₂ P-25
 가
 UV 30
 TiO₂
 P-25
 가
 가
 5 가 95%
 TiO₂ P-25

가
 P-25
 TiO₂ 가
 가
 가
 TiO₂ 가
 P-25
 가
 가
 4.
 (TTIP)
 TiO₂
 XRD SEM
 가
 TiO₂
 가
 SEM
 35~65nm
 가
 TiO₂ UV
 가

Table 2 Comparison of P-25 and combustion-synthesized TiO₂ particles

Catalyst	Synthesized Method	Average Particle Size (nm)	Anatase:Rutile Rate
Commercial P-25	Sol-gel of TiCl ₄	20~30	83 : 17
Combustion-Synthesized TiO ₂	Hydrogen Flame of TTIP	35~65	95 : 05

P-25
TiO₂
P-25
가
가
TiO₂ P-25
가 2 가
TiO₂ P-25
가 가

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