12th Joint Conference on Chemistry

Organized by:

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Certificate of Appreciation

No. /JCC12/Kimia.UNNES/2017

this certify that

Leny Yuliati

Presented a paper titled

Effect of Preparation Methods on the Activity of Titanium Dioxide-Carbon Nitride Composites for Photocatalytic Degradation of Salicylic Acid

at the 12th Joint Conference on Chemistry (JCC-12) 2017

held between 19th - 20th September 2017

at Aston Hotel and Convetion Centre, Semarang, Indonesia

KEMENTERIAN RISET TEKNOLOGI DAN PENDIDIKAN TINGGI UNIVERSITAS NEGERI SEMARANG FAKULTAS MATEMATIKA DAN ILMU PENGETAHUAN ALAM UNNES

Prof. Dr. Zaenuri M., S.E., M.Si., Akt.
Dean of Faculty of Mathematics and Natural Sciences
Universitas Negeri Semarang

Cepi Kurniawan, S.Si., M.Si., Ph.D.
Conference Chair

UNIVERSITAS
MA CHUNG

LETTER OF ASSIGNMENT

No: 253/MACHUNG/ST/IX/2017

The Rector of Universitas Ma Chung hereby assigns:

Name	:	Dr. Leny Yuliati
Employee's Number	:	20160018
Position	:	Principal Investigator of MRCPP

to participate in the **12th Joint Conference on Chemistry 2017 as Oral Presenter** with abstract entitled "**Effect of Preparation Methods on the Activity of Titanium DioxideCarbon Nitride Composites for Photocatalytic Degradation of Salicylic Acid**" organized by Chemistry Department of Universitas Negeri Semarang which is held on 19-20 September 2017 in Crystal Ballroom, Aston Hotel and Convention Centre, Semarang.

She has to submit an official report when returns to work.

Please be informed.

Malang, 8 September 2017
Rector,

MA CHUNG

Dr. Chatief Kunjaya

Acknowledged by,

(Name)

CC:
1. Vice Rectors
2. Ma Chung Research Center for Photosynthetic Pigments (MRCPP)
3. Human Resource Management

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12th Joint Conference on Chemistry

JCC12

2017

Program Book

Crystall Ballroom, Aston Hotel and Convention Centre, Semarang, Indonesia

19-20 September 2017
Semarang, Indonesia

Organized by:

UNNES

HKI

DAILY GRID

18 September 2017

18.30 – 21.00	**Wecloming Dinner**	**Aston Hotel ballroom**

19 September 2017

07.00-08.15	Registration
08.15-08.35	Opening Ceremony
	Indonesia National Athem
	Welcoming Dance
08.35-08.40	Chairman speech **Cepi Kurniawan, PhD**
08.40-08.50	Welcoming from the head of department
08.50-09.00	Welcoming speech and opening the conference by the Dean **Prof. Dr. Zaenuri M., S.E, M.Si, Akt.**
09.00-09.20	Coffee Break
09.20-10.00	**Prof. Guoping Chen** Hybrid Scaffolds of Biodegradable Polymers and Biomimetic Matrices for Tissue Engineering Applications
	Chair: Sri Kadarwati, PhD
10.00-11.00	**Prof. David Harding** Designing Molecular Switches: A Molecular Magnetism Approach
	Prof. Hadariah Bahron Imines and Metals: Marriage Made in Heavens
	Chair: M. Alauhdin, PhD
11.00-12.00	**Prof. Kasmadi Imam Kasmadi** The Cultivation of Religious Characters in Chemical Science Learning
	Prof. Subramaniam Ramanathan
	Chair: Sri Kadarwati, PhD
12.00-13.00	Lunch Break
13.00-14.00	**Prof. Ni Nyoman Tri Puspaningsih** Strengthening The Academic Network on Bioresource Technology Research towards Green Industry
	Prof. Hajime Hirao Computationally Exploring Complex Molecular Systems
	Chair: M. Alauhdin, PhD

BREAKOUT SESSION
19 September 2017

Time	ROOM A	ROOM B	ROOM C	ROOM D	ROOM E	ROOM F	ROOM G	ROOM H	ROOM I	Ballroom Poster		
14.00-14.15	JCC2017 262	JCC2017 SUP	JCC2017 135	JCC2017 RAW	JCC2017 AMF	JCC2017 SRA	JCC2017 KDN	JCC2017 DDH	JCC2017 212	JCC2017 207	JCC2017 016	JCC2017 063
14.15-14.30	JCC2017 278	JCC2017 155	JCC2017 131	JCC2017 166	JCC2017 014	JCC2017 134	JCC2017 306	JCC2017 MMM	JCC2017 254	JCC2017 007	JCC2017 305	JCC2017 308
14.30-14.45	JCC2017 278	JCC2017 270	JCC2017 179	JCC2017 167	JCC2017 123	JCC2018 SSS	JCC2017 224	jcc2017 144	JCC2017 079	JCC2017 199	JCC2017 311	JCC2017 172
14.45-15.00	JCC2017 125	JCC2017 298	JCC2017 185	JCC2017 258	JCC2017 088	JCC2017 074	JCC2017 006	JCC2017 008	JCC2017 103	JCC2017 189	JCC2017 255	jcc2017037
COFFEE BREAK (Parallel session is still continued)												
15.00-15.15	JCC2017 271	JCC2017 237	JCC2017 301	JCC2017 083	JCC2017 108	JCC2017 293	JCC2017 061	JCC2017 318	JCC2017 169	JCC2017 300	JCC2017 064	JCC2017 188
15.15-15.30	JCC2017 065	JCC2017 149	JCC2017 165	JCC2017 198	JCC2017 310	JCC2017 275	JCC2017 267	JCC2017 157	JCC2017 101	JCC2017 111	JCC2017 274	jcc2017 139
15.30-15.45	JCC2017 302	JCC2017 086	JCC2017 203	JCC2017 307	JCC2017 129	JCC2017 228	JCC2017 314	JCC2017 276	JCC2017 209	JCC2017 010	JCC2017 036	JCC2017 ATP

Time	ROOM A	ROOM B	ROOM C	ROOM D	ROOM E	ROOM F	ROOM G	ROOM H	ROOM I	Ballroom		
										Poster		
15.45-16.00	JCC2017 069	JCC2017 062	JCC2017 025	JCC2017 126	JCC2017 216	JCC2017 277	JCC2017 098	JCC2017 244	JCC2017 312	JCC2017 022	JCC2017 222	JCC2017 028
16.00-16.15	JCC2017 122	JCC2017 247	JCC2017 118	JCC2017 226	JCC2017 313	JCC2017 313	JCC2017 283	JCC2017 178	JCC2017 157	JCC2017 073	JCC2017 206	JCC2017 317
16.15-16.30	JCC2017 193	JCC2017 197	JCC2017 248	JCC017 WST	JCC2017 144	JCC2017 310	JCC2017 263	JCC2017 240	JCC2017 AHW	JCC2017 304	JCC2017 BBB	JCC2017 315
										JCC2017 309	JCC2017 BCH	JCC2017 SHR
										JCC2017 PLS		
16.45 – 17.00	CLOSING											

REG. CODE	Title	Author(s)
JCC2017254	Assessment of Drug Binding Potential of Pockets in the NS2B/NS3 Dengue Virus Protein	Fitri Amelia1, Iryani1, Prima Yulia Sari1, ArliAditya Parikesit2, Ridla Bakri2, Erwin Prasetya Toepak2, Usman Sumo Friend T
JCC2017255	Potentials of n-Heksan, Aseton and Ethanol Fraction Extract in Palmyra Fruit (BorassusflabelliferL.) as Antioxidant	Sukmawati
JCC2017258	Synthesis of Eugenol−Lauryl Methacrylate Copolymers via Cationic Polymerization	Aisyah Fajrin1, Soerya Dewi Marliana1, Desi Suci Handayani1
JCC2017262	Modification of montmorillonite with tetraethyl ortosilicate (TEOS) and cetyltrimethylammonium bromide (CTAB)	Dian M. Widjonarko, Oktaviana D. Mayasari, Khoirina D. Nugrahaningtyas, Sayekti
JCC2017263	Chemical Characteristics And Fatty Acid Profile Of Butterfly Tree Seed Oil (Bauhinia Purpurea L)	H Soetjipto* , C A Riyanto* T Victoria*
JCC2017267	Effect of Temperature to Adsorption Capacity and Coefficient Distribution on Rare Earth Elements Adsorption (Y, Gd, Dy) Using SIR	Nofriady Aziz1, Aswati Mindaryani2, Supranto2, Agus Taftazani3, Dwi Biyantoro3
JCC2017270	The Wastewater Treatment Processes and Mechanism of Organic Matter Removal by Modified Multi-Soil-Layering System	Roy Andreas1, Irmanto1
JCC2017271	Quantitative Analysis of Curcuminoid Collected from Different Location in Indonesia by TLC-Densitometry and Its Antioxidant Capacity	Dinar Sari C. Wahyuni1, AnifNur Artanti1, Yudi Rinanto2
JCC2017274	Photocatalyst of Perovskite CaTiO3 Nanopowder Synthesized from CaO derived from Snail Shell and Comparison with CaO and CaCO3	Is Fatimah1, Yeka Rahmadianti1, RizkyAyu Pudiasari1
JCC2017275	Surface and Groundwater Interactions: Cikapundung Bandung, Kanal BanjirTimur Semarang and CisadaneTangerang	Dasapta Erwin Irawan1, Endah Sulistyawati2, AleciaArtita Midori3, Budi Faisal3
JCC2017276	Effect of Ratio of Sugar Palm Fruit (Arengapinnata) and Carrageenan and Citric Acid on Moisture Content, Biodegradability, and Functional Groups of Biodegradable Film	Safira Aulia Rinanda1, Muhammad Nastabiq1,Sonya Hakim Raharjo1, Shifa Karima Hayati1, Muhammad Ainul Yaqin1, and Ratnawati1
JCC2017277	The role of pectin in Pb binding by carrot peel biosorbents : Isoterm adsorption Study	Budi Hastuti, and DwiSiswanta
JCC2017278	Curcuminoid content of Curcuma longa L. and Curcuma xanthorrhiza rhizome based on drying method with NMR and HPLC-UVD	Saptono Hadi 1* , Dinar Sari C. Wahyuni 1 , Anif Nur Artanti 1 , Yudi Rinanto 2
JCC2017283	Effect of Preparation Methods on the Activity of Titanium Dioxide-Carbon Nitride Composites for Photocatalytic Degradation of Salicylic Acid	Leny Yuliati1-3, AzlanMohd Salleh4, MohdHayrieMohd Hatta4, Hendrik O. Lintang1-3
JCC2017293	Separation of Gadolinium (Gd) Using SinergisSolven Mixed Topo -D2ehpa With Extraction Method	Nuradam Effendy1, Kris Tri Basuki1, Dwi Biyantoro2, Nizar Kamil Pewira1

JCC2017283
Effect of Preparation Methods on the Activity of Titanium Dioxide-Carbon Nitride Composites for Photocatalytic Degradation of Salicylic Acid

Leny Yuliati[1-3], Azlan Mohd Salleh[4], Mohd Hayrie Mohd Hatta[4], Hendrik O. Lintang[1-3]
[1]Ma Chung Research Center for Photosynthetic Pigments, Universitas Ma Chung, Indonesia, [2]Department of Chemistry, Faculty of Science and Technology, Universitas Ma Chung, Indonesia, [3]Centre for Sustainable Nanomaterials, Ibnu Sina Institute for Scientific and Industrial Research, Universiti Teknologi Malaysia, Malaysia, [4]Department of Chemistry, Faculty of Science, Universiti Teknologi Malaysia, Malaysia
E-mail : leny.yuliati@machung.ac.id

Titanium dioxide has been recognized as an active photocatalyst especially forwater treatment technology.[1)] Unfortunately, the anatase titanium dioxide can only be activated by ultraviolet (UV) light while the rutile form can only extend its absorption near visible light irradiation due to its large band gap energy, which are 3.20 and 3.03 eV, respectively.[2)] Since solar spectrum consists of more visible part than UV light, designing visible light active photocatalyst is crucial. Carbon nitride has been one of the potential visible light active photocatalysts that can be prepared by a cheap precursor such as urea.[3)]In this study, titanium dioxide-carbon nitride composites were prepared by three methods, which were one pot oxidation, impregnation, and physical mixing.Investigating the effect of these preparation methods is an important approach to develop highly active photocatalysts.

Each series of the photocatalysts were prepared with different ratios of titanium to carbon, *i.e.*, 1, 5, 10, 20, and 50 mol%. All samples were characterized by X-ray diffraction (XRD) and diffuse reflectance ultraviolet-visible (DRUV-Vis) spectroscopies. The characterization results confirmed the successful preparation of titanium dioxide, carbon nitride, and the titanium dioxide-carbon nitride composites. Photocatalytic activity tests were carried out for degradation of salicylic acid at room temperature under UV and visible light irradiations. It was confirmed that all the prepared titanium dioxide-carbon nitride composites showed better photocatalytic activities than the bare titanium dioxide and bare carbon nitride. Under UV light irradiation, 90.6% of salicylic acid degradation was achieved on the best composite prepared by one pot oxidation with 5 mol% of titanium to carbon (Ti/C) ratio.On the other hand, the highest degradation under visible light irradiation was 94.30%, observed on the composite that was prepared also by one pot oxidation method with the Ti/C ratio of 10%. Therefore, among the investigated methods, the best method to prepare the titanium dioxide-carbon nitride composites with high photocatalytic activity was one pot oxidation method. Owing to the higher conduction band of titanium dioxide than the carbon nitride, the excited electrons would be transferred from the conduction band of titanium dioxideto the conduction band of carbon nitride. This would reduce the electron recombination rate in the titanium dioxide,which would result in the synergic effect to enhance the activity of the composites. Under UV light irradiation, in addition to the generated holes on titanium dioxide, generated holes oncarbon nitridewould also react with salicylic acid to finally produce water and carbon dioxide.On the other hand, under visible light irradiation, the generated holes on the carbon nitride would be the main active species that would oxidize the salicylic acid.

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EFFECT OF PREPARATION METHODS ON THE ACTIVITY OF TITANIUM DIOXIDE-CARBON NITRIDE COMPOSITES FOR PHOTOCATALYTIC DEGRADATION OF SALICYLIC ACID

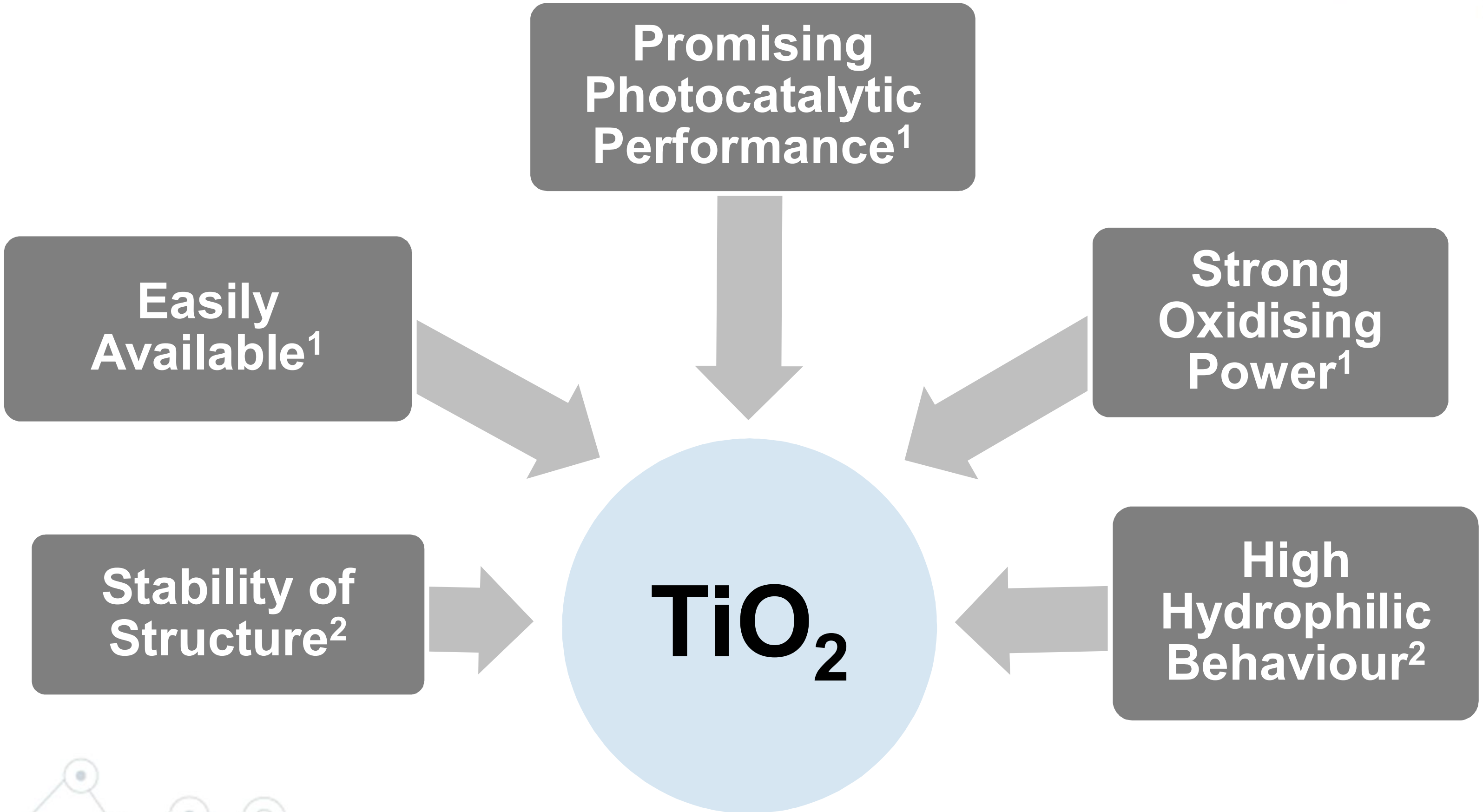
Leny Yuliati
Azlan Mohd Salleh
Mohd Hayrie Mohd Hatta
Hendrik O. Lintang

KERANA TUHAN UNTUK MANUSIA
UNIVERSITI TEKNOLOGI MALAYSIA

Ma Chung Research Center
for Photosyntetic Pigments

INTRODUCTION (1)

Advantages of TiO_2 Photocatalyst



[1] Wang *et al.*, 2002, *Surface and Coatings Tech.*, **155**, 141-145.
[2] Lee *et al.*, 2008, *Mat. Chem. and Phys.*, **109**, 275-280.

INTRODUCTION (2)

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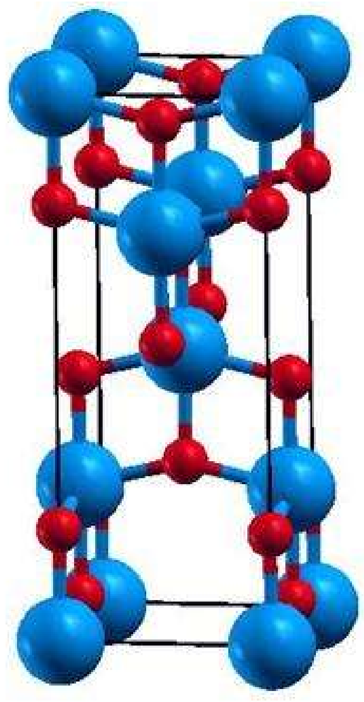
Drawbacks of TiO_2 Photocatalyst



Anatase

Anatase: 3.2 eV

Poor Absorption of Visible Light

High Rate of Electron-Hole Recombination

Low Quantum Yield and Poor Efficiency of Photocatalyst

Zhang, *et al.*, 2010, *Transition Met. Chem.*, **35**, 933-938.

INTRODUCTION (3)

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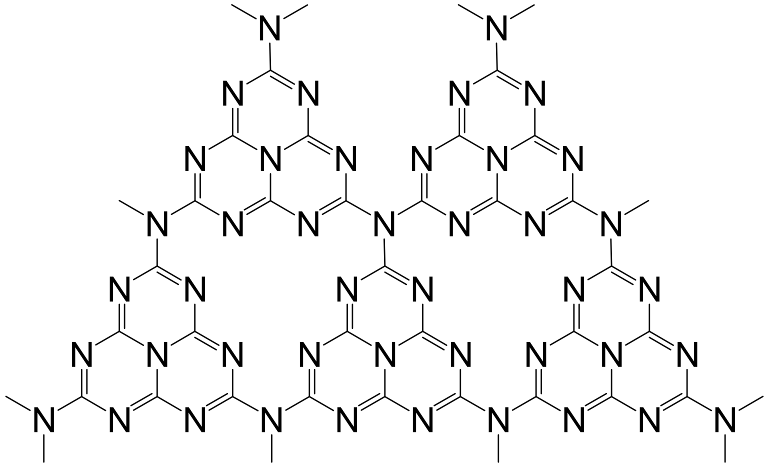
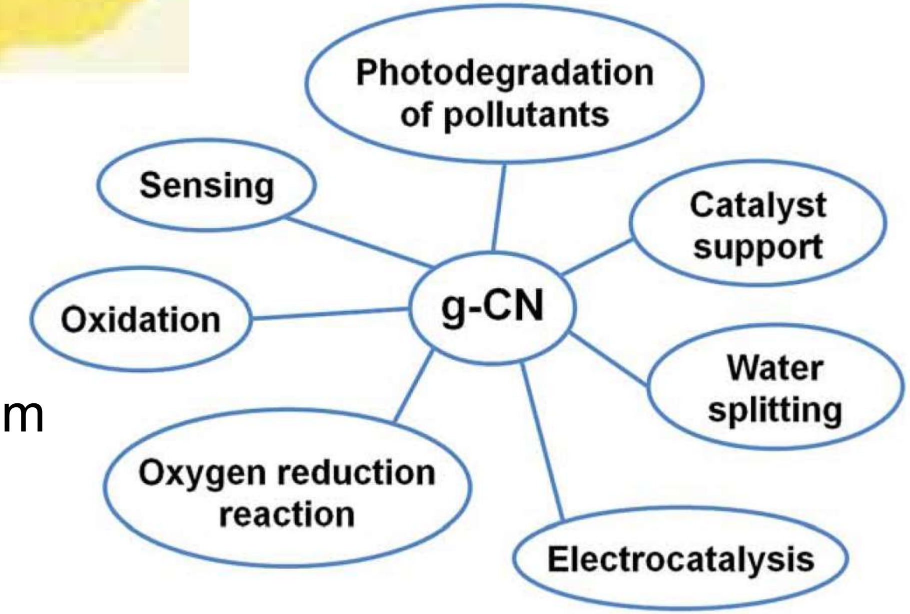
Graphitic Carbon Nitride (CN)



- Metal-free
- Visible light absorption up to *ca.* 460 nm
- High stability
- High photocatalytic activity



Wang *et al.*, 2012, *Angewandte Chem. Int. Ed.*, **51**, 68-89.
Thomas *et al.*, 2008, *J. Mater. Chem.*,**18**, 4893-4908.
Yang *et al.*, 2015, *J. Mater. Chem. A*.,**3**, 14081-14092.

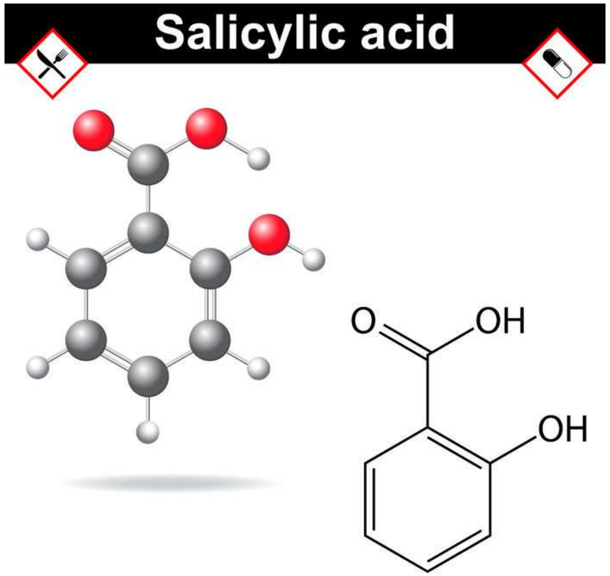
INTRODUCTION (4)

Salicylic Acid

In the present study, the TiO_2-CN composites were prepared by **three methods, namely one pot oxidation, impregnation, and physical mixing.**
Investigating the effect of these preparation methods is an important approach to develop highly active photocatalysts.

The composites were evaluated for **degradation of salicylic acid** as one of the organic pollutants.

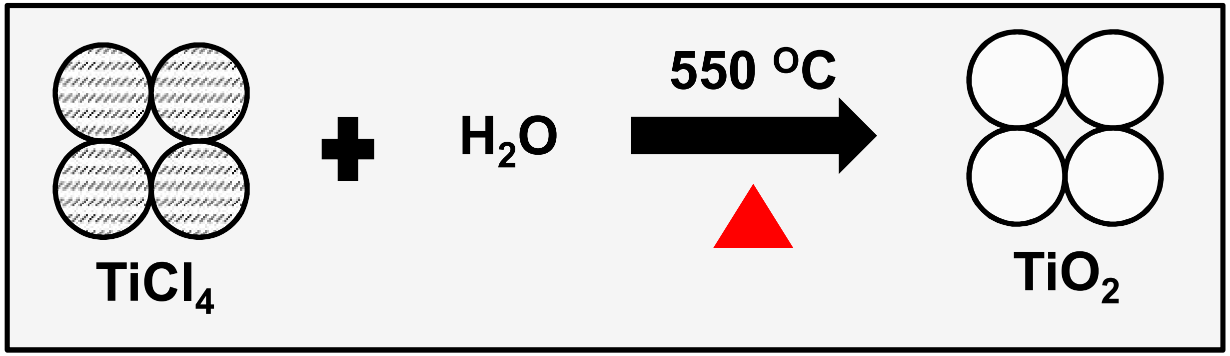
Salicylic acid is toxic[1] and can be found in wastewater from many industries.[2]



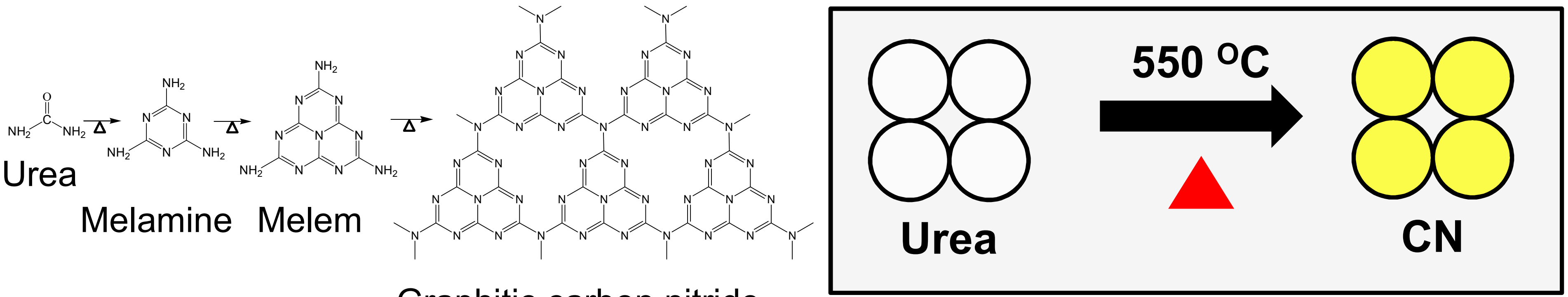
[1] Hayat *et al.*, 2010, *Envi. and Exp. Botany*, **68**, 14-25.
[2] Loh *et al.*, 2005, *Sensors and Act. B Chem.*, **107**, 59-63.

EXPERIMENTAL METHODS (1)

Preparation of TiO_2



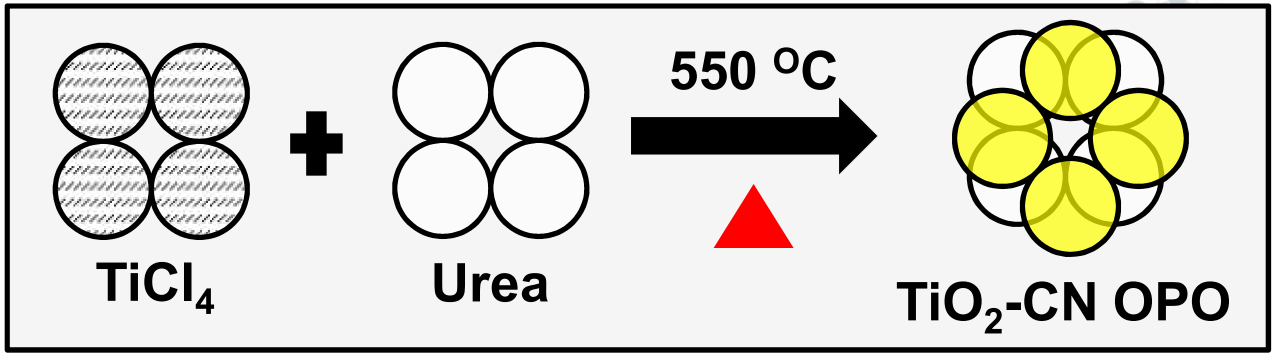
Preparation of CN



EXPERIMENTAL METHODS (2)

Preparation of TiO_2-CN OPO

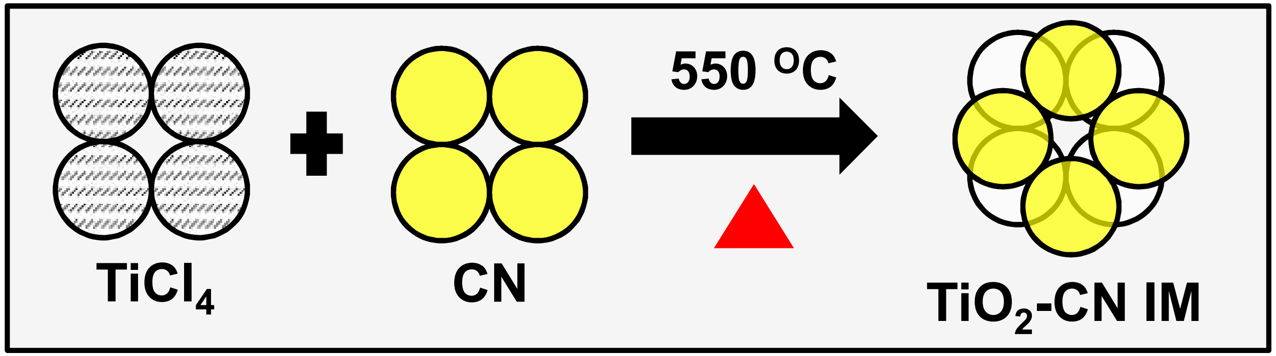
One Pot Oxidation Method



Various mol ratios of Ti/C (x = 1, 5, 10, 20, and 50 mol%).

Preparation of TiO_2-CN IM

Impregnation Method



Various mol ratios of Ti/C (x = 1, 5, 10, 20, and 50 mol%).

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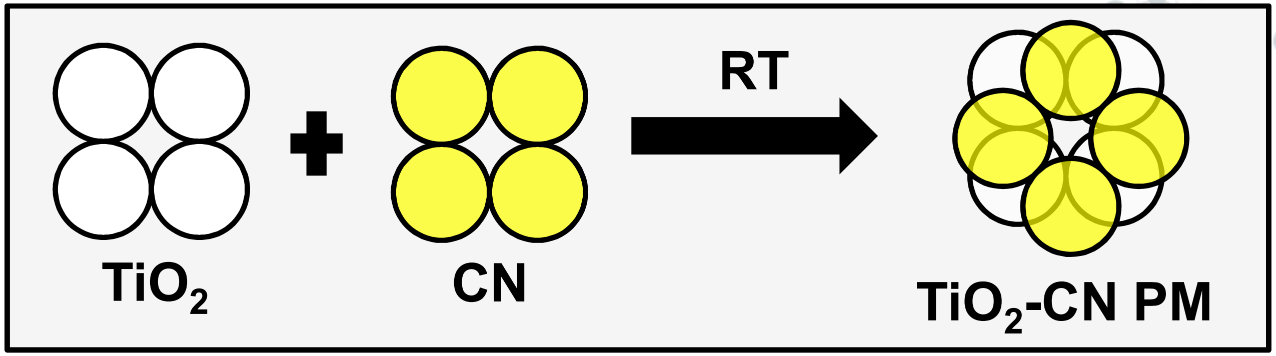
EXPERIMENTAL METHODS (3)

Preparation of TiO_2-CN PM

Physical Mixing Method



Various mol ratios of Ti/C (x = 1, 5, 10, 20, and 50 mol%).

Characterizations

X-ray diffractometer

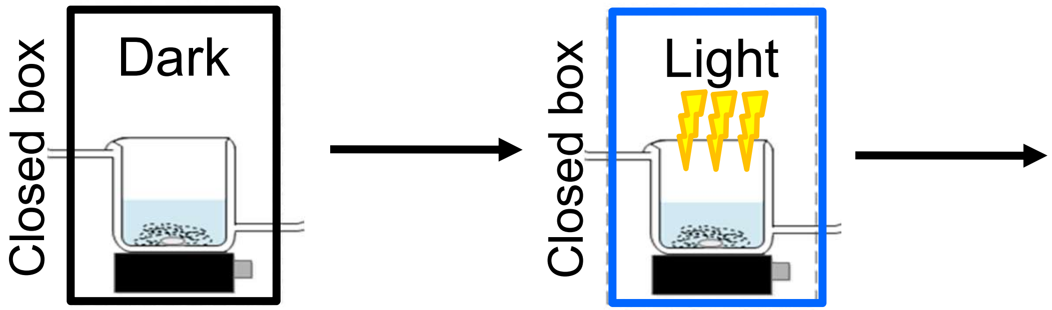
DR UV-visible spectrophotometer

EXPERIMENTAL METHODS (4)

Photocatalytic Degradation of Salicylic Acid

- Photocatalyst (**50 mg**)
- Salicylic acid (**100 μM, 50 mL**)
- Stirred under dark condition (**1 h**)

- Photocatalyst (**50 mg**)
- Salicylic acid (**100 μM, 50 mL**)
- Stirred under UV lamp 8 W (**6 h**) or stirred under visible lamp 150 W (**6 h**)



Analysis by UV-Vis spectroscopy

$$\textbf{Degradation of SA (\%)} = \frac{\text{Conc. of SA after dark} - \text{Conc. of SA after reaction}}{\text{Conc. of SA after dark}} \times 100\%$$

RESULTS AND DISCUSSION (1)

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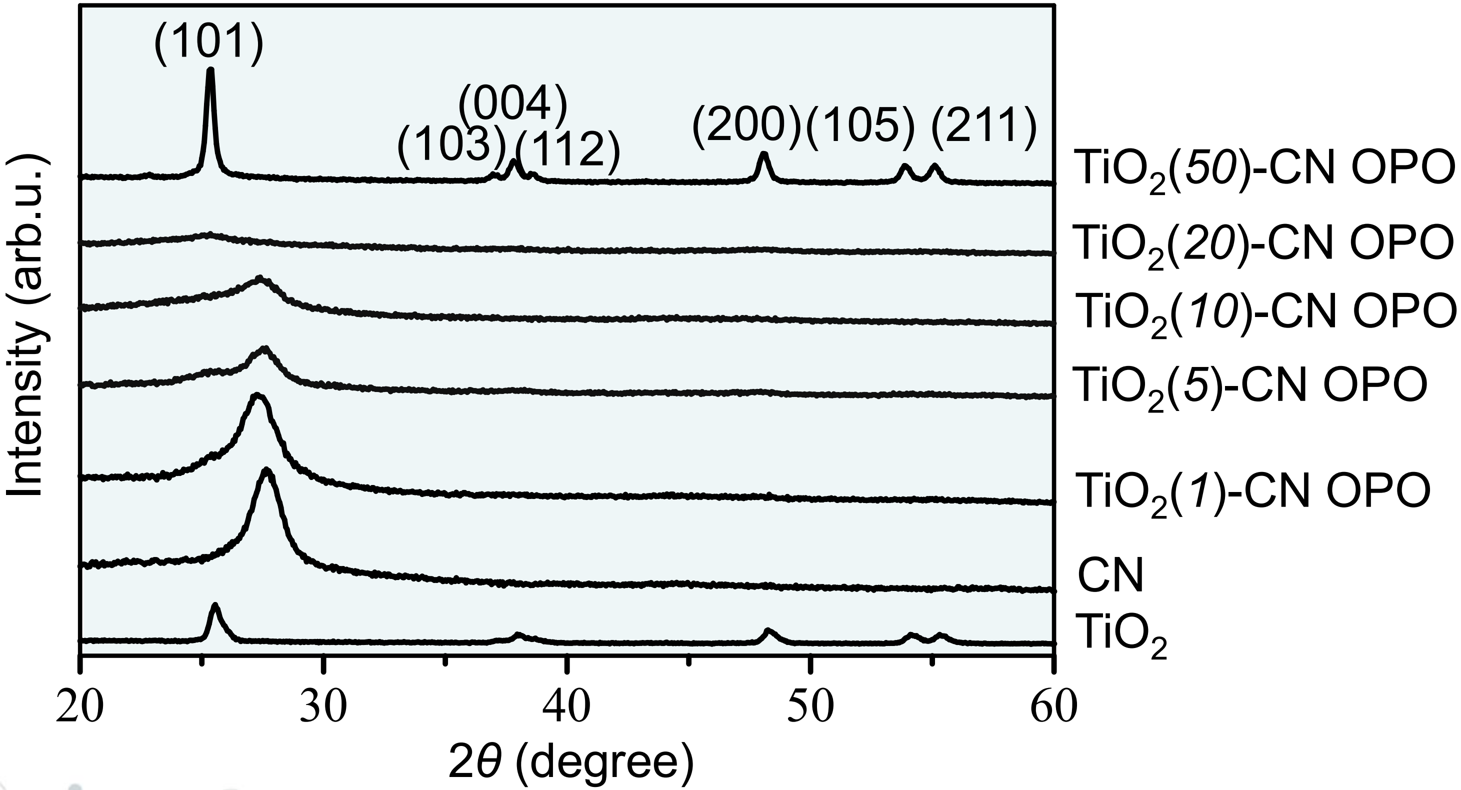
Structural Properties of TiO_2-CN OPO Composites

XRD patterns



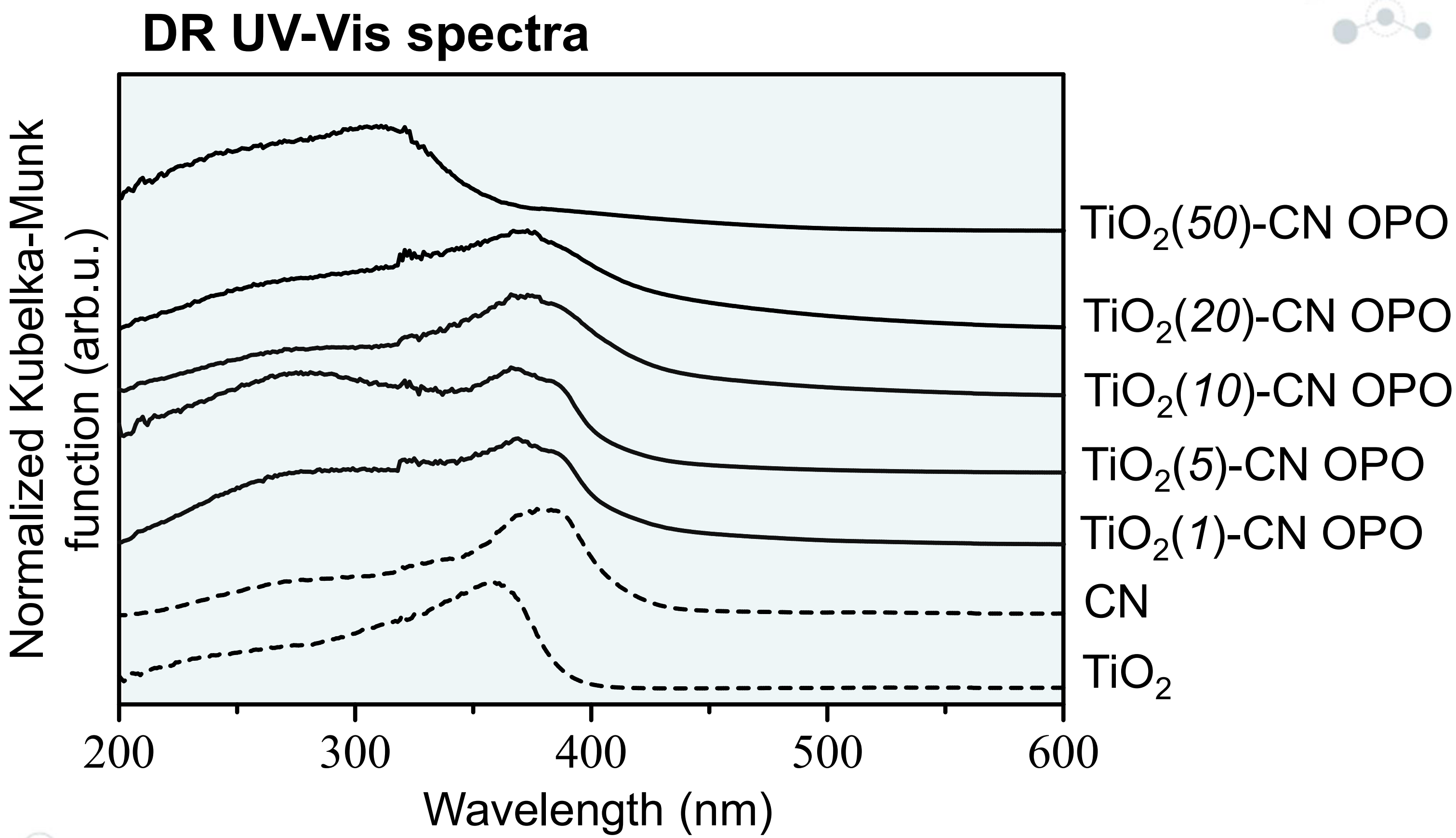
TiO_2 has the anatase crystal structure.

One peak around 28^o was observed on the CN due to the interlayer spacing of the CN.

When the ratio of Ti/C was low, the composite samples only showed the main peak of CN. With the increase of Ti/C ratio, the CN could be decomposed and the peak of TiO_2 became the dominant diffraction peaks.

RESULTS AND DISCUSSION (2)

Optical Properties of TiO_2-CN OPO Composites



With addition of CN, the composite samples showed absorption in visible region above 400 nm, suggesting that they have good ability to absorb visible light and might show good activity under visible light irradiation.

RESULTS AND DISCUSSION (3)

Ma Chung Research Center for Photosyntetic Pigments

Photocatalytic Activity of TiO_2-CN OPO Composites

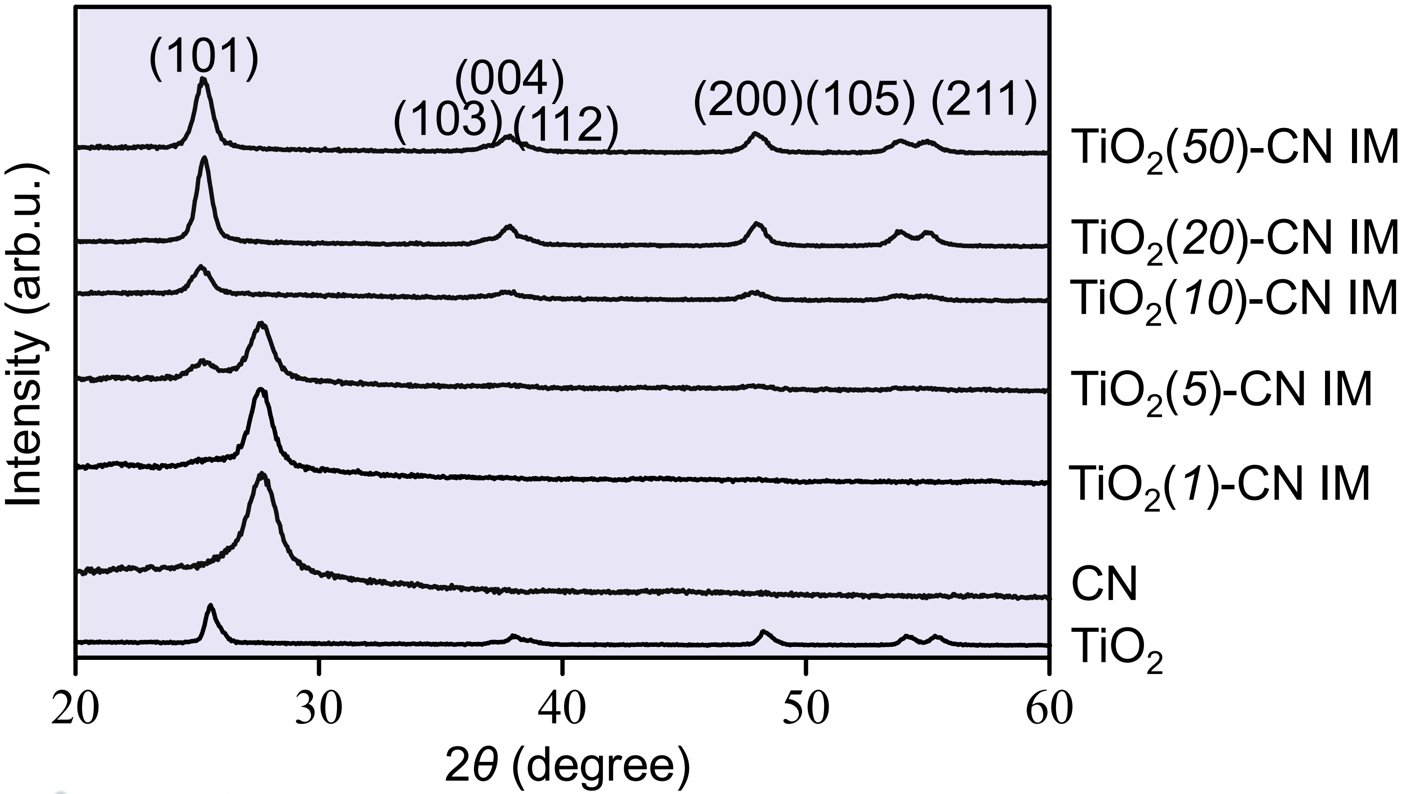
Preparation Method	Sample	Percentage of Degradation (%)	
		Under UV light	Under visible light
One Pot Oxidation	CN	33.7	43.0
	TiO_2(*1*)-CN OPO	67.3	60.6
	TiO_2(*5*)-CN OPO	90.6	91.6
	TiO_2(*10*)-CN OPO	77.4	94.3
	TiO_2(*20*)-CN OPO	82.6	84.1
	TiO_2(*50*)-CN OPO	79.6	77.7
	TiO_2	60.9	21.4

All **TiO_2-CN composites showed better activity** than the CN or TiO_2.
Samples with low Ti/C ratio (**5-10 mol%**) showed the best performance.

RESULTS AND DISCUSSION (4)

Structural Properties of TiO_2-CN IM Composites

XRD patterns



TiO_2 has the anatase crystal structure.

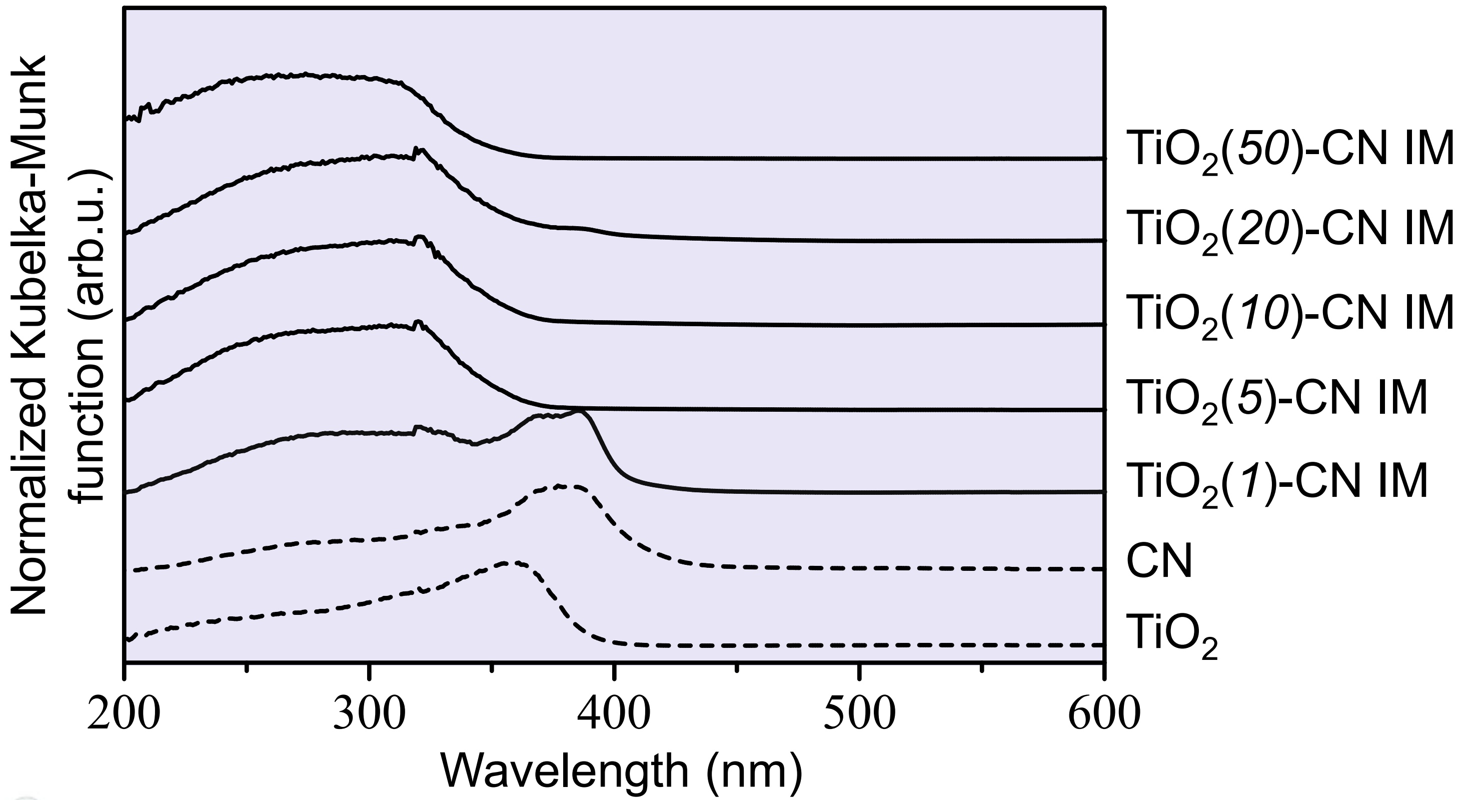
One peak around 28^o was observed on the CN due to the interlayer spacing of the CN.

Composites with low Ti/C ratio (1-5%) were mainly characterized by the CN peak, while high Ti/C ratio ($\geq$ 10%) were dominated with the TiO_2. The CN might be decomposed easier when heated in the presence of TiO_2.

RESULTS AND DISCUSSION (5)

Optical Properties of TiO_2-CN IM Composites

DR UV-Vis spectra



Only TiO_2(*1*)-CN IM composite showed absorption in the visible light region above 400 nm. On the other hand, with the increase amount of Ti/C ratio, the absorption in visible light region decreased and shifted to lower wavelength.

RESULTS AND DISCUSSION (6)

Photocatalytic Activity of TiO_2-CN IM Composites

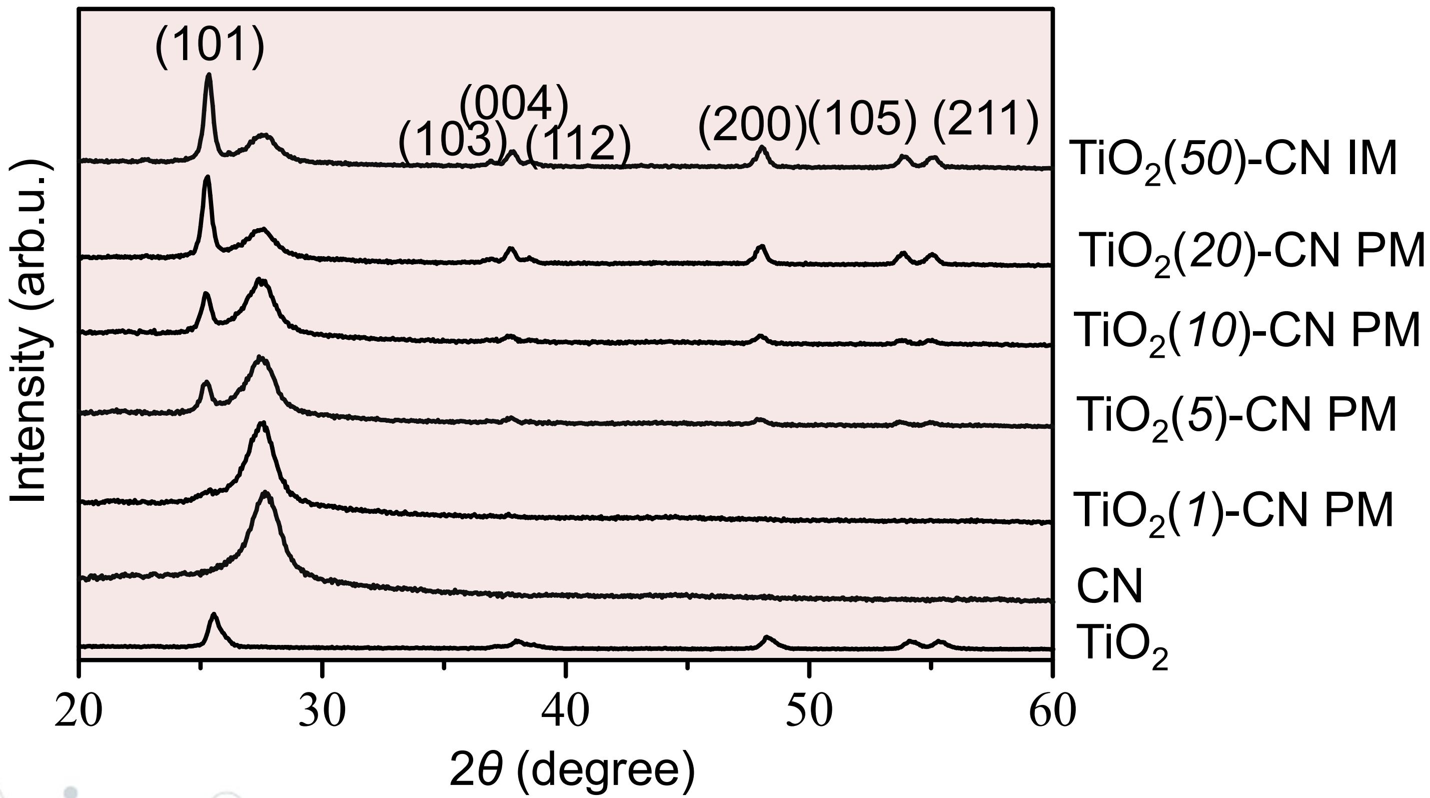
Preparation Method	Sample	Percentage of Degradation (%)	
		Under UV light	Under visible light
Impregnation	CN	33.7	43.0
	TiO_2(*1*)-CN IM	70.7	65.1
	TiO_2(*5*)-CN IM	$\boxed{89.7}$	82.6
	TiO_2(*10*)-CN IM	77.0	$\boxed{86.7}$
	TiO_2(*20*)-CN IM	67.3	81.0
	TiO_2(*50*)-CN IM	66.4	78.0
	TiO_2	60.9	21.4

All **TiO_2-CN composites showed better activity** than the CN or TiO_2. Samples with low Ti/C ratio (**5-10 mol%**) showed the best performance, but slightly lower activity than the TiO_2-CN OPO composites.

RESULTS AND DISCUSSION (7)

Structural Properties of TiO_2-CN PM Composites

XRD patterns



TiO_2 has the anatase crystal structure.

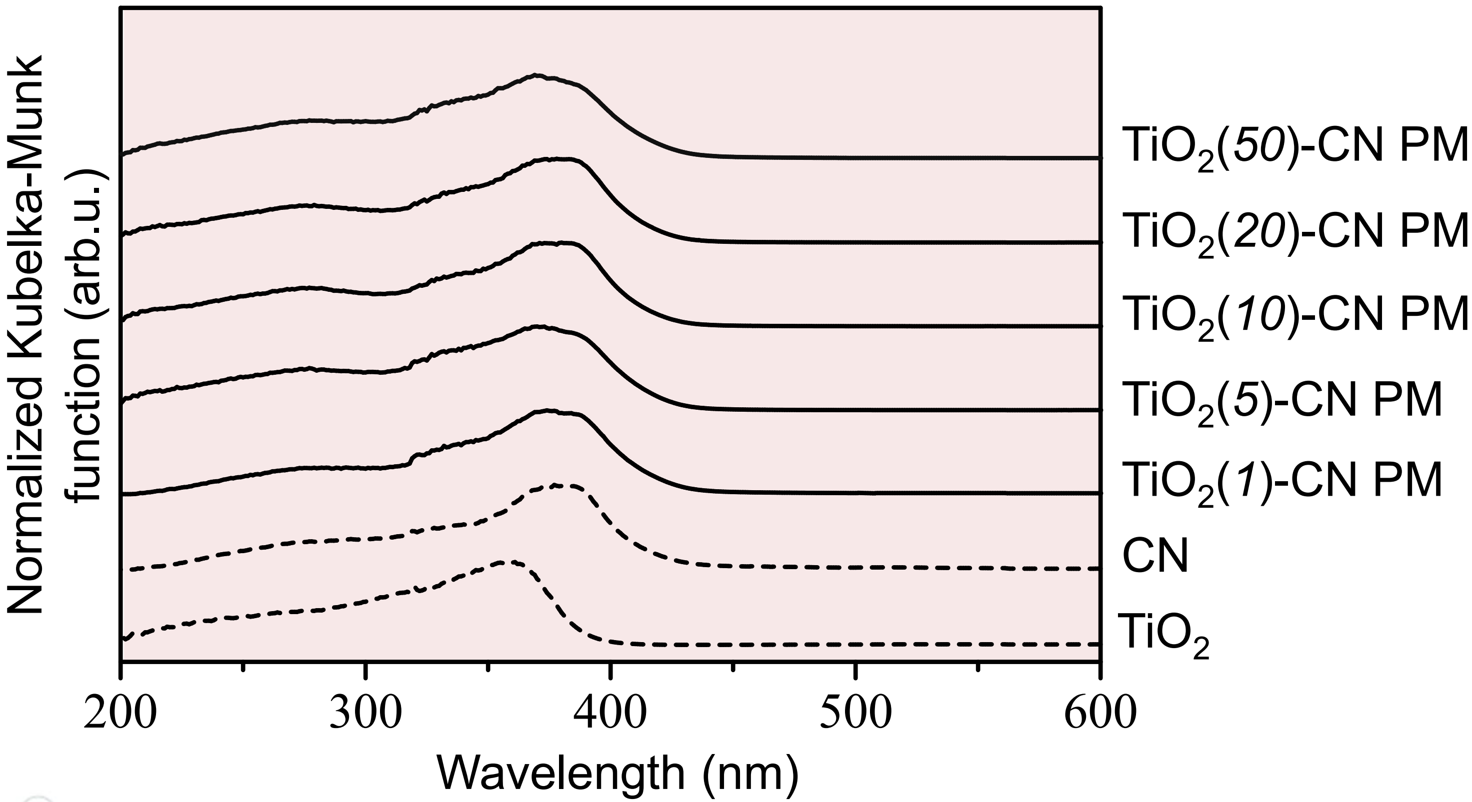
One peak around 28^o was observed on the CN due to the interlayer spacing of the CN.

Composite with low Ti/C ratio *i.e.*, $TiO_2(x)$-CN PM only exhibited the CN peak. All composites with Ti/C ratio of more than 5% showed the diffraction peaks of both TiO_2 and CN, suggesting the presence of both TiO_2 and CN.

RESULTS AND DISCUSSION (8)

Optical Properties of TiO_2-CN PM Composites

DR UV-Vis spectra



All composites exhibited similar absorption spectrum to each other regardless the difference in the Ti/C ratio. All composites showed the characteristics of light absorption for both TiO_2 and CN.

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RESULTS AND DISCUSSION (9)

Photocatalytic Activity of TiO_2-CN PM Composites

Preparation Method	Sample	Percentage of Degradation (%)	
		Under UV light	Under visible light
Physical Mixing	CN	33.7	43.0
	TiO_2(1)-CN PM	80.0	71.4
	TiO_2(5)-CN PM	79.7	56.7
	TiO_2(10)-CN PM	78.1	56.3
	TiO_2(20)-CN PM	76.1	46.3
	TiO_2(50)-CN PM	81.0	62.4
	TiO_2	60.9	21.4

All **TiO_2-CN composites showed better activity** than the CN or TiO_2.
All composites showed similar activity of *ca.* 80% under UV light.
Under visible light, the activity was observed to be *ca.* 40–70%.

Ma Chung Research Center for Photosyntetic Pigments

RESULTS AND DISCUSSION (10)

Activity Comparison

All **TiO_2-CN composites showed better activity** than the CN or TiO_2, suggesting the synergic effect between the CN and TiO_2.

Both under UV and visible light irradiation, the activity is in the order of:

TiO_2-CN OPO > TiO_2-CN IM > TiO_2-CN PM

Even though TiO_2-CN PM showed the characteristics of both CN and TiO_2, the activity was not as high as other composites. Physical mixing might not be able to provide strong interface interactions.

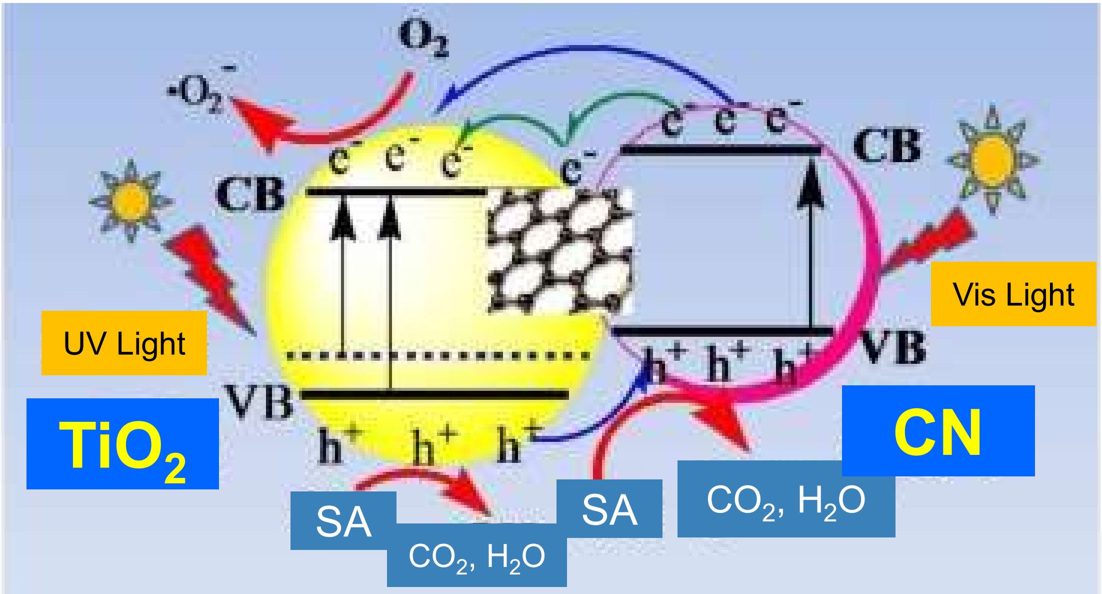
In contrast, the one pot oxidation method could provide **stronger interactions between the CN and TiO_2**. The composites prepared by one pot oxidation method might **induce better charge transfer**, which lead to **lower electron-hole recombination**. As a result, the composites prepared by one pot oxidation method would give **better photocatalytic activity.**

RESULTS AND DISCUSSION (11)

Proposed Mechanism

Under light irradiation with enough energy, the **electrons** in the valence bands of both TiO_2 and CN in the composite will be **excited** to the conduction bands.

Since the conduction band of TiO_2 is higher than the conduction band of CN, the **excited electrons will be transferred** from the conduction band of TiO_2 **to the conduction band of CN.** Thus, the **electron recombination rate of photoexcited TiO_2 will be reduced**, giving the increased activity.



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CONCLUSIONS

1. TiO_2-CN composites could be prepared by one pot oxidation, impregnation, and physical mixing.

2. Among the three methods, the composites prepared by **one pot oxidation method showed the highest photocatalytic activity** for degradation of salicylic acid both under UV and visible light irradiation.

3. The synergic effect between TiO_2 and CN in the composite was proposed to **reduce the electron-hole recombination in the TiO_2**, resulting in the better photocatalytic activity of the composite than the bare TiO_2 and the bare CN.

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ACKNOWLEDGEMENTS

This work was financially supported by Ministry of Higher Education (MOHE) through the Fundamental Research Grant Scheme (cost center code: R.J130000.7826.4F002). The academy of sciences for the developing world (TWAS) is also greatly acknowledged via COMSTECHTWAS joint research grants programme for young scientists (cost center code: R.J130000.7320.4B039).

Financial supports to attend the JCC 2017 from MRCPP, Universitas Ma Chung is also greatly acknowledged.