

**PHOTOCATALYTIC AND ANTIBACTERIAL PROPERTIES
UNDER UV LIGHT OF
TiO₂ IMPREGNATED BACTERIAL CELLULOSE**

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A Thesis Submitted in Partial Fulfillment of the Requirements
for the Degree of Master of Science
The Petroleum and Petrochemical College, Chulalongkorn University
in Academic Partnership with
The University of Michigan, The University of Oklahoma,
and Case Western Reserve University

2011

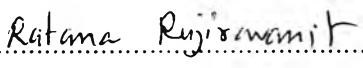
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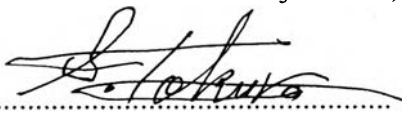
Thesis Title: Photocatalytic and Antibacterial Properties under UV Light of
TiO₂ Impregnated Bacterial Cellulose
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Program: Polymer Science
Thesis Advisors: Assoc. Prof. Ratana Rujiravanit
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Accepted by The Petroleum and Petrochemical College, Chulalongkorn University, in partial fulfilment of the requirements for the Degree of Master of Science.

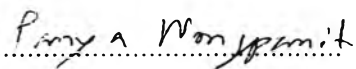

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บทคัดย่อ

ณัฐกมล จันทร์เพชร : สมบัติโฟโตคะตะไลติกและการต้านเชื้อแบคทีเรียของไททานเนียมไดออกไซด์ที่ถูกฝังในแบคทีเรียเซลลูโลส (Photocatalytic and Antibacterial Properties under UV Light of TiO₂ Impregnated Bacterial Cellulose) อ. ที่ปรึกษา : รองศาสตราจารย์ ดร.รัตนา รุจิรวนิช และศาสตราจารย์ ดร. เซอิชิ โทคุระ 62 หน้า

ปัญหาการปนเปื้อนสารพิษและเชื้อโรคในแหล่งน้ำยังคงเป็นปัญหาใหญ่ในปัจจุบัน ซึ่งมีวิธีการบำบัดเพื่อแก้ปัญหาดังกล่าวมากมาย รวมไปถึงการใช้โฟโตคะตะลิสในการส่งเสริมปฏิกิริยาโฟโตคะตะไลติก โดยมีการรายงานว่าปฏิกิริยาโฟโตคะตะไลติกนั้นเป็นวิธีที่มีประสิทธิภาพในการบำบัดสารพิษและกำจัดเชื้อโรค ซึ่งไททานเนียมไดออกไซด์เป็นสารอนินทรีย์โฟโตคะตะลิสที่ได้รับการพิสูจน์แล้วว่ามีความสามารถสูงในการใช้ประโยชน์ด้านสิ่งแวดล้อมอย่างกว้างขวาง ในการศึกษาครั้งนี้แบคทีเรียเซลลูโลสถูกเลือกนำมาใช้เป็นแผ่นรองรับไททานเนียมไดออกไซด์ เนื่องจากโครงสร้างมีรูพรุนและมีพื้นที่ผิวสูง ซึ่งจะสามารถเป็นตัวส่งเสริมปฏิกิริยาโฟโตคะตะไลติกของไททานเนียมไดออกไซด์ได้ ดังจะเห็นได้จากการกำจัดสีเมทิลีนบลู รวมไปถึงการต้านเชื้อแบคทีเรียสายพันธุ์อีโคไล(แบคทีเรียแกรมลบ) และแบคทีเรียสายพันธุ์เอสออเรียส(แบคทีเรียแกรมบวก)

ABSTRACT

5272011063: Polymer Science Program

Nattakammala Janpetch: Photocatalytic and Antibacterial Properties under UV Light of TiO₂ Impregnated Bacterial Cellulose.

Thesis Advisors: Assoc. Prof. Ratana Rujiravanit ,and Prof. Seiichi Tokura 62 pp.

Keywords: Antibacterial/ Bacterial cellulose/ Nanofibers/ Photocatalytic/ Titanium dioxide/ UV irradiation

Nowadays, toxic and pathogenic contamination in water has become a serious pollution problem. Several treatments have been proposed to solve the problem including the use of photocatalysts to promote photocatalytic reactions. Photocatalytic reactions have been reported to be an efficient method to treat various toxic substances as well as pathogenic microorganisms. Among the inorganic photocatalysts, TiO₂ has proven as the most promising photocatalyst capable of being utilized for a wide range of environmental applications. In this study, TiO₂ was impregnated into a bacterial cellulose (BC) matrix. Due to its porous structure and high surface area, the BC was found to be a good support for photocatalytic reactions of TiO₂. Methylene blue, a basic dye, was used as a model to determine photocatalytic efficiency of the TiO₂ impregnated bacterial cellulose on the methylene blue removal. In addition, antibacterial property against *S. aureus*, a gram positive bacterium, and *E. coli*, a gram negative bacterium, of the TiO₂ impregnated bacterial cellulose was also investigated.

ACKNOWLEDGEMENTS

First and foremost, his all attitudes should go to Associate Professor Ratana Rujiravanit, his advisor, whose encouragement, continuous guidance, invaluable suggestion, constructive criticism and intensive support from the initial to the final level enabled him to accomplish the present thesis. He also wishes to acknowledge gratefully his excellent way of teaching of both research skills and scientific knowledge.

He would like to express his thanks to Professor Seiichi Tokura, his co-advisor

He would like to thank Asst. Prof. Thammanoon Sreethawong and Dr. Panya Wongpanit for being his thesis committee and offering worth advices and fruitful suggestions.

He is indebted to all Professors at the Petroleum and Petrochemical College, Chulalongkorn University, for their dedicated devotion in tendering in-depth knowledge on polymer science. He would like to offer his regards to all faculty members who supported him in any respect during the completion of the thesis.

He is grateful for the funding of the thesis work provided by the Petroleum and Petrochemical College; and the National Center of Excellence for Petroleum, Petrochemicals, and Advanced Materials, Thailand.

He would like to give a sincere thank to all members in Ratana's and Pitt's laboratory for their helps, friendship, and good memories throughout his study. He also wishes to thank his friends at PPC who have made each day a new experience to him.

Last but not least, he would like to thank his family, his father, mother, grandmother, and brother, for their unconditional love, understanding, encouragement, and constant support throughout his life.

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ABBREVIATIONS

ATR	attenuated Total Reflectance
BC	bacterial cellulose
C	velocity of light
°C	degree Celcius
CB	conduction band
CO ₂	carbon dioxide
e ⁻	electron
e ⁻ -h ⁺	electron-hole pair
E	energy of a photon
<i>E. Coli</i>	<i>Escherichia coli</i>
E _g	band gap energy
etc.	etcetera
EtOH	ethanol
eV	electron volt
FE-SEM	Field Emission Scanning Electron Microscope
FTIR	fourier-transform infrared spectroscopy
Fe ₂ O ₃	iron oxide
GPa	gigapascal
h	Planck's constant
h ⁺	hole
H ⁺	proton
H ₂ O	water
H ₂ O ₂	hydrogen peroxide
hv	light energy source
ml	milliliter
·OH	hydroxyl radical
O ₂	oxygen
O ₂ ^{·-}	superoxides
·OOH	hydroperoxyl radical
OLED	organic light emitting diodes

P	pollutants
PVP	poly(vinylpyrrolidone)
<i>S. aureus</i>	<i>Staphylococcus aureus</i>
SC	semiconductor photocatalyst
SEM	scanning electron microscope
TISTR	Thailand institute of scientific and technological research
TiO ₂	titanium dioxide
TTIP	titanium tetraisopropoxide
UV	ultraviolet
VB	valence band
VOCs	volatile organic compounds
XRD	X-ray diffraction analysis
ZnO	zinc oxide
λ	wavelength
ν	frequency