PHOTOCATALYTIC AND ANTIBACTERIAL PROPERTIES UNDER UV LIGHT OF TiO_2 IMPREGNATED BACTERIAL CELLULOSE

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บทคัดย่อ

ณัฐกมลา จั่นเพ็ชร : สมบัติโฟโตคะตะไลติกและการต้านเชื้อแบคทีเรียของไททาเนียมไดออกไซด์ที่ถูกฝังในแบคทีเรียเซลลูโลส (Photocatalytic and Antibacterial Properties under UV Light of TiO_2 Impregnated Bacterial Cellulose) อ. ที่ปรึกษา : รองศาสตราจารย์ ดร.รัตนา รุจิรวนิช และศาสตราจารย์ ดร. เซอิชิ โทคุระ 62 หน้า

ปัญหาการปนเปื้อนสารพิษและเชื้อโรคในแหล่งน้ำยังคงเป็นปัญหาใหญ่ในปัจจุบัน ซึ่งมีวิธีการบำบัดเพื่อแก้ปัญหาดังกล่าวมากมาย รวมไปถึงการใช้โฟโตคะตะลิสในการส่งเสริมปฏิกิริยาโฟโตคะตะไลติก โดยมีการรายงานว่าปฏิกิริยาโฟโตคะตะไลติกนั้นเป็นวิธีที่มีประสิทธิภาพในการบำบัดสารพิษและกำจัดเชื้อโรค ซึ่งไททาเนียมไดออกไซด์เป็นสารอนินทรีย์โฟโตคะตะลิสที่ได้รับการพิสูจน์แล้วว่ามีความสามารถสูงในการใช้ประโยชน์ด้านสิ่งแวดล้อมอย่างกว้างขวาง ในการศึกษาครั้งนี้แบคทีเรียเซลลูโลสถูกเลือกนำมาใช้เป็นแผ่นรองรับไททาเนียมไดออกไซด์ เนื่องจากโครงสร้างมีรูพรุนและมีพื้นที่ผิวสูง ซึ่งจะสามารถเป็นตัวส่งเสริมปฏิกิริยาโฟโตคะตะไลติกของไททาเนียมไดออกไซด์ได้ ดังจะเห็นได้จากการกำจัดสีเมทิลลีนบูล รวมไปถึงการต้านเชื้อแบคทีเรียสายพันธ์อีโคไล(แบคทีเรียแกรมลบ) และแบคทีเรียสายพันธ์เอสออเรียส (แบคทีเรียแกรมบวก)

ABSTRACT

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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, TiO_2 has proven as the most promising photocatalyst capable of being utilized for a wide range of environmental applications. In this study, TiO_2 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 TiO_2. Methylene blue, a basic dye, was used as a model to determine photocatalytic efficiency of the TiO_2 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 TiO_2 impregnated bacterial cellulose was also investigated.

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ABBREVIATIONS

ATR	attenuated Total Reflectance
BC	bacterial cellulose
C	velocity of light
°C	degree Celcious
CB	conduction band
CO_2	carbon dioxide
e^-	electron
e^-–h^+	electron-hole pair
E	energy of a photon
E. Coli	*Escherichia coli*
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_2O_3	iron oxide
GPa	gigapascal
h	Planck's constant
h^+	hole
H^+	proton
H_2O	water
H_2O_2	hydrogen peroxide
hν	light energy source
ml	milliliter
$^{\bullet}OH$	hydroxyl radical
O_2	oxygen
$O_2^{\bullet-}$	superoxides
$^{\bullet}OOH$	hydroperoxyl radical
OLED	organic light emitting diodes

P	pollutants
PVP	poly(vinylpyrrolidone)
S. aureus	*Staphylococcus aureus*
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