PREPARATION OF NOVEL INORGANIC-ORGANIC HYDRID MATERIALS BY TEMPLATE-DIRECTED SYNTHESIS USING BACTERIAL CELLULOSE AS A MATRIX

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A Dissertation Submitted in Partial Fulfilment of the Requirements
for the Degree of Doctor of Philosophy
The Petroleum and Petrochemical College, Chulalongkorn University
in Academic Partnership with
The University of Michigan, The University of Oklahoma,
and Case Western Reserve University
2013

I28372955 561054

Thesis Title:	Preparation of Novel Inorganic-Organic Hybrid Materials by Template-Directed Synthesis Using Bacterial Cellulose as a Matrix
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ABSTRACT

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Thesis Advisors: Assoc Prof. Ratana Rujiravanit *(Thai Advisor)* and Prof. Hiroshi Tamura *(Overseas Advisor)*.
Keywords: Inorganic-Organic Hybrid Materials/ Bacterial Cellulose/ Magnetic Particles/ Silver Particles/ Zinc Oxide Particles

In the present study, the novel inorganic–organic hybrid materials of magnetic particles, silver particles, zinc oxide particles and bacterial cellulose (BC) were successfully prepared by using template-directed synthesis method. The cations precursor of magnetic, silver and zinc oxide particles were firstly homogeneously dispersed into the BC matrix. Then, the dispersed-cations were converted to be metal or metal oxide particles inside BC matrix. By using BC as a template, the homogeneously distribution with optimizing particle size of the as-synthesized metal and metal oxide particles inside BC matrix were successfully achieved. These were resulted in the synergistic properties between the as-synthesized metal or metal oxide particles and BC matrix. The as-prepared samples were investigated by scanning electron microscope (SEM), transmission electron microscope (TEM), energy dispersive X-ray (EDX), X-ray diffraction (XRD) techniques and thermogravimetric analysis (TGA). The magnetic and electric properties of the as-prepared magnetic particle, silver particle and magnetic/silver particle incorporated-BC samples were studied by using the vibrating sample magnetometry (VSM) and two points probe conductivity meter, respectively. Finally, the photo-catalytic activities of the as-prepared zinc oxide particle incorporated-bacterial cellulose samples were studied by monitoring the antibacterial activity of the as-prepared sample.

บทคัดย่อ

ชื่อ ชัยพฤกษ์ นามสกุล เกตุเพ็ชร : ชื่อหัวข้อวิทยานิพนธ์ (ภาษาไทย) การเตรียมวัสดุลูกผสมระหว่างสาร อนินทรีย์และสารอินทรีย์ชนิดใหม่ผ่านกระบวนการการสังเคราะห์โดยใช้เส้นใยแบคทีเรียเซลลูโลสเป็นโครงร่าง (ภาษาอังกฤษ) (Preparation of Novel Inorganic-Organic Hybrid Materials by Template-Directed Synthesis Using Bacterial Cellulose as a Matrix) อ. ที่ปรึกษา : รศ. รัตนา รุจิรวนิช และ ศ. ฮิโรชิ ทามูระ 181 หน้า

ในงานวิจัยนี้ ได้ประสบความสำเร็จในการเตรียมวัสดุลูกผสมระหว่างสารอนินทรีย์และสารอิททรีย์ ที่ประกอบด้วย อนุภาคแม่เหล็ก อนุภาคเงิน อนุภาคซิงค์ออกไซค์ และ เส้นใยเซลลูโลส ซึ่งเตรียมผ่านกระบวนการ การสังเคราะห์โดยใช้เส้นใยแบคทีเรียเซลลูโลสเป็นโครงร่าง โดยที่ สารตั้งต้นในการสังเคราะห์ อนุภาคแม่เหล็ก อนุภาคเงิน และ อนุภาคซิงค์ ออกไซค์ ซึ่งอยู่ในรูปของไอออนบวก จะถูกดูดซับและกระจายตัวอย่างสม่ำเสมอในเมตริกซ์ของเส้นใยแบคทีเรียเซลลูโลสหลังจากนั้นสารตั้งต้นดังกล่าวจะถูกปลี่ยนเป็นอนุภาคแม่เหล็ก อนุภาคเงิน อนุภาคซิงค์ออกไซค์และตกตะกอนอยู่ในเมตริกซ์ของเส้นใยแบคทีเรียเซลลูโลส ซึ่งการใช้กระบวนการเตรียมดังกล่าวร่วมกับเส้นใยแบคทีเรียเซลลูโลสเป็นเมตริกซ์ สามารถเหนี่ยวนำให้เกิดอนุภาคโลหะ และอนุภาคโลหะออกไซค์ ที่มีขนาดอนุภาคที่เหมาะสมและมีการกระจายตัวอย่างสม่ำเสมอตลอดทั้งเมตริกซ์ได้ โดยสมบัติของวัสดุลูกผสมที่เตรียมได้นั้นจะสามารถวิเคราะห์ได้โดยเทคนิคดังต่อไปนี้ Scanning electron microscope (SEM) transmission electron microscope (TEM) energy dispersive X-ray (EDX) X-ray diffraction (XRD) และ thermo gravimetric analysis (TGA) โดยที่ สมบัติทางแม่เหล็กและสมบัติทางไฟฟ้าของ เส้นใยแบคทีเรียเซลลูโลสที่ประกอบด้วยอนุภาคแม่เหล็ก เส้นใยแบคทีเรียเซลลูโลสที่ประกอบด้วยอนุภาคเงิน และ เส้นใยแบคทีเรียเซลลูโลสที่ประกอบด้วยทั้งอนุภาคแม่เหล็กและอนุภาคเงิน สามารถวิเคราะห์ได้โดยเทคนิค vibrating sample magnetometry (VSM) และ two points probe conductivity meter ตามลำดับ นอกจากนั้น สมบัติ photocatalytic activities ของ เส้นใยแบคทีเรียเซลลูโลสที่ประกอบด้วยอนุภาคซิงค์ ออกไซค์ สามารถศึกษาได้ ผ่านการศึกษาฤทธิ์ในการต้านเชื้อแบคทีเรียของตัวอย่างใยแบคทีเรียเซลลูโลสที่ประกอบด้วยอนุภาคซิงค์ ออกไซค์ที่เตรียมได้

ACKNOWLEDGEMENTS

This work is greatly supported in cash and in kind by the Chulalongkorn University Dutsadi Phiphat Scholarship, the Rachadapisek Somphot Endowment Fund, The Petroleum and Petrochemical College, Chulalongkorn University, Thailand, The Conductive and Electroactive Polymers Research Unit and Kansai University, are greatly acknowledged.

This thesis work is funded by the Petroleum and Petrochemical College; and Center of Excellence on Petrochemical and Materials Technology, Thailand.

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