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PLATINUM NANOPARTICLES SYNTHESIZED *VIA*
GREEN NANOTECHNOLOGY

Miss Duangta Tongsakul

A Dissertation Submitted in Partial Fulfillment of the Requirements
for the Degree of Doctor of Philosophy Program in Petrochemistry

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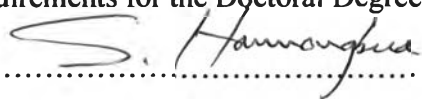
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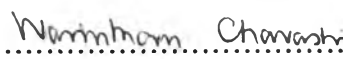
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ดวงตา ทองสกุล : อนุภาคระดับนาโนเมตรของแพลทินัมสังเคราะห์ด้วยนาโนเทคโนโลยีที่เป็นมิตรกับสิ่งแวดล้อม. (PLATINUM NANOPARTICLES SYNTHESIZED VIA GREEN NANOTECHNOLOGY) อ. ที่ปรึกษาวิทยานิพนธ์หลัก: รศ. ดร. สนอง เอกสิทธิ์, อ. ที่ปรึกษาวิทยานิพนธ์ร่วม: รศ. ชูชาติ ธรรมเจริญ), 117 หน้า.

โครงสร้างระดับนาโนเมตรของแพลทินัม เช่น คอลลอยด์อนุภาคระดับนาโนเมตรของแพลทินัม ตัวเร่งปฏิกิริยาแพลทินัมแบบเนื้อผสมและเส้นใยห้าเหลี่ยมกลวงของแพลทินัม ถูกสังเคราะห์ขึ้นมาด้วยวิธีการที่เป็นมิตรต่อสิ่งแวดล้อม สารตั้งต้นที่เป็นมิตรต่อสิ่งแวดล้อม คือ แป้งที่ละลายน้ำได้แสดงศักยภาพในการทำหน้าที่เป็นได้ทั้งตัวรีดิวส์และสารช่วยเสถียรในสถานะต่าง ตัวกลางที่ถูกสร้างขึ้นมาจากการสลายตัวของแป้งสามารถรีดิวส์ไอออนของโลหะแพลทินัม และช่วยรักษาเสถียรภาพของอนุภาคระดับนาโนเมตรของแพลทินัมให้มีขนาดที่สม่ำเสมอ (2-4 นาโนเมตร) วิธีการที่พัฒนาขึ้นได้นำไปใช้ต่อในการเตรียมตัวเร่งปฏิกิริยาแบบเนื้อผสมบนตัวรองรับไฮโดรทัลไซต์ โดยการเร่งปฏิกิริยาถูกประเมินสำหรับการทำปฏิกิริยาออกซิเดชันของกลีเซอรอลในตัวกลางที่เป็นน้ำปราศจากเบส โดยมีโมเลกุลออกซิเจนเป็นสารออกซิแดนซ์ ตัวเร่งปฏิกิริยาแสดงความเลือกสรรที่สูงไปยังกรดกลีเซอริก ยิ่งไปกว่านั้นตัวเร่งปฏิกิริยาดังกล่าวสามารถนำกลับมาใช้ซ้ำได้อย่างน้อย 3 ครั้ง เส้นลวดห้าเหลี่ยมกลวงของแพลทินัมสร้างได้จากการแทนที่กัลวานิกกับเส้นใยเงิน โดยเส้นใยเงินที่มีความยาวพิเศษโดยมีสัดส่วนความยาวต่อเส้นผ่านศูนย์กลางสูงถึง 7500 ถูกสร้างขึ้นมาจากการแทนที่กัลวานิกของไอออนโลหะเงินกับอลูมิเนียมฟรอยด์ที่มีขายในเชิงพาณิชย์ โครงสร้างเส้นใยเงินที่ได้ถูกนำไปใช้เป็นต้นแบบในการสร้างเส้นใยห้าเหลี่ยมกลวงของแพลทินัม โดยเส้นใยกลวงที่ได้ยังคงรูปร่างเป็นเส้นใยยาวเหมือนต้นแบบ แม้ว่าจะมีการล้างตะกอนของเกลือคลอไรด์ของโลหะเงินออกไปแล้ว โครงสร้างเส้นใยกลวงที่ได้มีความหนาของผนังในระดับนาโนเมตรที่น่าจะมีศักยภาพในการประยุกต์ใช้เป็นตัวเร่งปฏิกิริยา

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ASSOC. PROF. SANONG EKGASIT, Ph.D., CO-ADVISOR: ASSOC.
PROF. CHUCHAAT THAMMACHAROEN, 117 pp.

Platinum nanostructures such as colloidal platinum nanoparticles, supported platinum nanoparticles heterogeneous catalyst, and platinum pentagonal hollow fibers were successfully synthesized using “Green” synthesis approach. The green reagent, soluble starch shows the efficiency as a reducing and a stabilizing agent under alkaline treatment. The *in situ* generated reducing species (intermediates of starch degradation) could completely reduce platinum ions and sufficiently stabilize the obtained platinum nanoparticles (Pt NPs) of uniform particle size (2–4 nm). The developed green approach is further used for preparation of hydrotalcite-supported platinum nanoparticles catalyst (Pt NPs/HT). Their catalytic activity is evaluated for selective oxidation of glycerol in a base-free aqueous solution using molecular oxygen as an oxidant. They show a high selectivity towards glyceric acid. In addition, the catalyst could be recycled at least for three times. Platinum pentagonal hollow wire could be obtained by the galvanic displacement with silver microfibers. Prior, the extra-long silver microfibers with aspect ratio as high as 7500 were synthesized galvanically from silver nitrate and a commercial aluminum foil. The enveloped of the silver fibers sacrificed template creates unique platinum pentagonal hollow fibers. The hollow fibers still retain the long fiber structure of the original template even after the removal of silver chloride precipitates. These hollow fibers with nanometer thick wall might have a great potential for applications as catalyst.

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