

**SYNTHESIS AND CHARACTERIZATION OF POLYANILINE  
NANOPARTICLES BY USING TEMPLATE TECHNIQUE**



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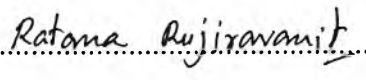
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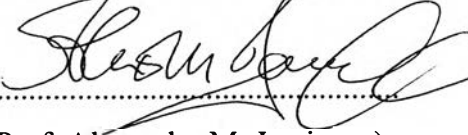
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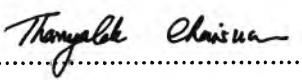
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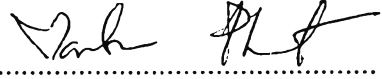
  
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## ABSTRACT

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Keywords: Polyaniline/ Nanoparticles/ Chlorophyllin/ Carboxymethyl chitin/ Template/ Rheology

Various morphologies of polyaniline (PANI) nanoparticles, including nanofibrils, dendrites, and spheres, were synthesized by oxidative polymerization of aniline in the presence of different types of templates those are chlorophyllin, carboxymethyl chitin (CM-chitin), and partially cross-linked carboxymethyl chitin, respectively. The pristine PANI nanoparticles are obtained after removing the templates by simply washing with specific solvents. Contrary, irregularly-shaped aggregates with a diameter greater than 1  $\mu\text{m}$  are obtained by using the conventional method (without the addition of templates). Molecular characterizations (including UV-vis, FTIR, TGA, and XRD) suggest an identical structure between PANI synthesized with and without templates. The morphology and size of the synthesized PANI products are also dependent on various parameters, *e.g.* structure of the template materials, the ratio of monomer to template, and the synthetic conditions. CM-chitin template can be applied to synthesize a spherical shape of polypyrrole (PPY) nanoparticles as well. In a preparation of nanocomposite films, it is further explored that the synthesized PPY nanoparticles are better dispersed in the CM-chitin matrix than that of the conventional particles. Rheological measurements indicate that the addition of PPY nanoparticles can decrease the viscosity of alginate. In contrast, the increase of suspension viscosity is observed when adding the larger size of conventional PPY in alginate. The distinct rheological behaviours are influenced by the size of PPY nanoparticles as well as the electronic state of PPY nanoparticles.

## บทคัดย่อ

ทัศน์พล รัชพิชชา: การสังเคราะห์และวิเคราะห์สมบัติของพอลิอะนิลีนที่มีอนุภาคขนาดนาโนเมตรโดยใช้เทคนิคเทมเพลต (Synthesis and Characterization of Polyaniline Nanoparticles by using Template Technique) อ. ที่ปรึกษา : รศ. ดร. รัตนา รุจิรวนิช และ ศ. ดร. อเล็กซานเดอร์ เอ็ม จามิสัน 206 หน้า

พอลิอะนิลีนที่มีขนาดอนุภาคอยู่ในระดับนาโนเมตรและมีลักษณะทางสัณฐานวิทยาที่แตกต่างกันไป ได้แก่ ลักษณะที่เป็นแบบเส้นใยขนาดเล็ก ลักษณะที่เป็นแบบเส้นโคโรล และลักษณะที่เป็นแบบทรงกลม สามารถสังเคราะห์ได้จากปฏิกิริยาพอลิเมอไรเซชันแบบออกซิเดชันของอะนิลีนในสารที่ทำหน้าที่เป็นเทมเพลต ได้แก่ สารคลอโรฟิลลิน สารคาร์บอกซีเมธิลไคติน และสารคาร์บอกซีเมธิลไคตินที่มีการเชื่อมขวางของโครงสร้างเป็นแบบร่างแห ตามลำดับ สารเทมเพลตที่เหลือจากการสังเคราะห์พอลิอะนิลีนที่มีขนาดอนุภาคอยู่ในระดับนาโนเมตรนั้นสามารถกำจัดออกได้ง่ายโดยใช้ตัวทำละลายของสารเทมเพลตเหล่านั้น ในทางกลับกันการสังเคราะห์พอลิอะนิลีนแบบวิธีทั่วไปที่ไม่ใช้สารเทมเพลตจะทำให้ได้พอลิอะนิลีนที่มีรูปร่างไม่สม่ำเสมอ มีการเกาะติดกันของอนุภาคจนมีขนาดที่ใหญ่กว่า 1 ไมโครเมตร จากการวิเคราะห์ทางโมเลกุลโดยใช้เทคนิค ยูวี-วิชันเบิลสเปกโตรสโคปี ฟลูออโรสเปกโตรสโคปี เทอร์โมกราวิเมตริกอะนาไลซิส และเอ็กซ์เรย์ดีฟรैคชันอะนาไลซิส บ่งบอกถึงการมีโครงสร้างทางเคมีที่เหมือนกันของพอลิอะนิลีนที่สังเคราะห์ได้ไม่ว่าจะเป็นจากเทคนิคที่ใช้สารเทมเพลตหรือไม่ใช้สารเทมเพลต นอกจากนี้ยังพบว่าลักษณะทางสัณฐานวิทยาและขนาดอนุภาคของพอลิอะนิลีนที่สังเคราะห์ได้จะขึ้นกับตัวแปรต่างๆ เช่น โครงสร้างของสารเทมเพลต สัดส่วนของอะนิลีนต่อสารเทมเพลต และสภาวะที่ใช้ในการสังเคราะห์พอลิอะนิลีน นอกจากนี้สารคาร์บอกซีเมธิลไคตินยังใช้เป็นเทมเพลตในการสังเคราะห์พอลิไพโรโรลที่มีลักษณะเป็นแบบทรงกลมได้อีกด้วย ในส่วนของการเตรียมสารประกอบนาโนคอมพอสิต จะพบว่าพอลิไพโรโรลที่มีขนาดอนุภาคอยู่ในระดับนาโนเมตรจะมีการกระจายตัวในสารตัวกลางคาร์บอกซีเมธิลไคตินที่ดีกว่าพอลิไพโรโรลที่สังเคราะห์จากวิธีการทั่วไป และจากการทดลองเพื่อศึกษาสมบัติการไหลของพอลิไพโรโรลในสารละลายแอลจินเนตพบว่า การเติมพอลิไพโรโรลที่มีขนาดอนุภาคอยู่ในระดับนาโนเมตรทำให้ความหนืดของสารละลายแอลจินเนตลดลงซึ่งต่างจากการเติมพอลิไพโรโรลที่สังเคราะห์จากวิธีการทั่วไปที่มีขนาดใหญ่กว่าจะทำให้ความหนืดของสารละลายแอลจินเนตเพิ่มขึ้น ซึ่งพฤติกรรมทางการไหลที่ต่างกันนั้นมีอิทธิพลมาจากความแตกต่างของขนาดอนุภาคของพอลิไพโรโรลและสภาวะทางไฟฟ้าด้วย

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