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SYNTHESIS OF TITANIUM NITRIDE FIBERS FROM ELECTROSPUN
TITANIA/POLYMER COMPOSITE NANOFIBERS

Miss Tawiporn Wongkhearw

A Thesis Submitted in Partial Fulfillment of the Requirements
for the Degree of Master of Engineering Program in Chemical Engineering

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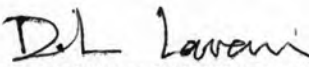
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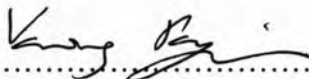
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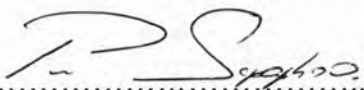
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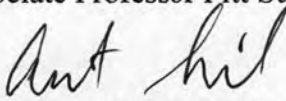

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ทวิพร วงศ์เขียว : การสังเคราะห์เส้นใยไทเทเนียมไนไตรด์จากเส้นใยขนาดนาโนของไทเทเนียม/พอลิเมอร์คอมพอสิตที่เตรียมจากการปั่นด้วยไฟฟ้าสถิต. (SYNTHESIS OF TITANIUM NITRIDE FIBERS FROM ELECTROSPUN TITANIA/POLYMER COMPOSITE NANOFIBERS.) อ.ที่ปรึกษา: ผศ.ดร.วงศ์ ปวรอาจารย์, อ.ปรึกษาร่วม: รศ.ดร.พิชญ์ ศุภผล, 105 หน้า.

เส้นใยไทเทเนียมไนไตรด์ซึ่งเป็นเซรามิกส์ที่ไม่มีออกซิเจน สามารถใช้ในงานที่มีความเครียดทางกลสูงภายใต้อุณหภูมิสูง และทนต่อการกัดกร่อนของสารเคมีได้ดี สามารถสังเคราะห์ได้จากเส้นใยของไทเทเนียม/พอลิเมอร์คอมพอสิตที่เตรียมได้จากวิธีโซล-เจลและการปั่นด้วยไฟฟ้าสถิต โดยเส้นใยนี้จะถูกเผาในบรรยากาศของอาร์กอนที่อุณหภูมิ 600 องศาเซลเซียสเพื่อเปลี่ยนพอลิเมอร์ให้เป็นคาร์บอนอิสระ เส้นใยที่ได้มีการหดสั้นลงและมีขนาดของเส้นผ่านศูนย์กลางลดลง หลังจากนั้นเส้นใยนี้จะถูกเปลี่ยนให้เป็นเส้นใยไทเทเนียมไนไตรด์ด้วยกระบวนการคาร์โบเทอร์มอลรีดักชันและไนไตรด์เคชันที่อุณหภูมิ 1400 องศาเซลเซียส โดยเส้นใยจะเปลี่ยนเป็นไทเทเนียมคาร์ไบด์ก่อนในช่วงการเพิ่มอุณหภูมิของระบบและจะเปลี่ยนเป็นเส้นใยไทเทเนียมไนไตรด์เมื่อป้อนก๊าซไนโตรเจนเข้าสู่ระบบ เส้นใยไทเทเนียมไนไตรด์ที่สังเคราะห์ได้จะมีขนาดอยู่ในระดับนาโนเมตรเมื่อใช้พอลิไวนิลไพโรลิโดนที่มีมวลโมเลกุลสูงเป็นแหล่งของคาร์บอน นอกจากนี้ยังได้มีการใช้คาร์บอนแบล็คเป็นแหล่งของคาร์บอนในการศึกษานี้ โดยพบว่าสัดส่วนของไทเทเนียมไนไตรด์ที่สังเคราะห์ได้จากคาร์บอนแบล็คจะมากกว่าไทเทเนียมไนไตรด์ที่สังเคราะห์ได้จากพอลิไวนิลไพโรลิโดน และยังพบว่าสัดส่วนของปริมาณสารที่สังเคราะห์ได้เมื่อเพิ่มอัตราการไหลของไนโตรเจนเป็นสองเท่าจะไม่แตกต่างจากค่าที่ได้เมื่อใช้อัตราการไหลของไนโตรเจนปกติในการทดลอง

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TAWIPORN WONGKHEARW: SYNTHESIS OF TITANIUM NITRIDE FIBERS FROM ELECTROSPUN TITANIA/POLYMER COMPOSITE NANOFIBERS.

THESIS ADVISOR: ASST. PROF. VARONG PAVARAJARN, Ph.D.,

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Titanium nitride (TiN) is a non-oxide ceramic with high thermal, mechanical and chemical stabilities. Titanium nitride fibers were synthesized by carbothermal reduction and nitridation of titania/polymer composite nanofibers that were obtained from sol-gel process combined with electrospinning technique. The titania/polymer composite nanofibers were pyrolyzed in argon atmosphere at 600°C to break long hydrocarbon chains into free carbon. The obtained products were still in the form of fibers and exhibited significant shrinkage as well as a reduction in fiber diameter. After that, these pyrolyzed fibers were converted to titanium nitride by the carbothermal reduction and nitridation process at 1400°C. TiC was occurred during heating up to the reaction temperatura. Titanium nitride was formed when gas supplying to the reactor was changed to nitrogen. The diameter of the obtained titanium nitride fibers was in nanometer scale when hight molecular-weight polyvinylpyrolydone was used as carbon source. In addition, the use of carbon black as carbon source was also investigated in this study. As the result, the conversion of titanium nitride obtained, when carbon black was used, was higher than that from polyvinylpyrolydone. Moreover, doubled flow rate of nitrogen did not affect the reaction, such that the conversion was not different from regular flow rate.

Department...Chemical Engineering..... Student's signature...*Tawiporn Wongkhearw*.....
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