

**SILICA SURFACE MODIFIED BENZOXAZINE DIMER VIA  
MONOOXAZINE PATHWAY**

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for the Degree of Master of Science  
The Petroleum and Petrochemical College, Chulalongkorn University  
in Academic Partnership with  
The University of Michigan, The University of Oklahoma,  
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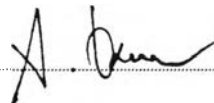
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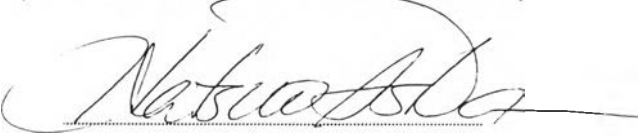
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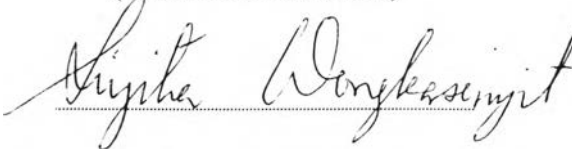
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## ABSTRACT

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KEYWORDS : Benzoxazine/ Monooxazine Dimer/ Silane Coupling Agent /Silica Surface / Ion Extraction Resin  
Yean Sok Chea: Silica Surface Modified Benzoxazine Dimer via Monooxazine Pathway. Thesis Advisors:  
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Silylbenzoxazine of 3,4-dihydro-3-triethoxysilyl-n-propyl-6-methyl-8-[(2'-hydroxy-5'-methylbenzyl)cyclohexylaminomethyl]-2H-1,3-benzoxazine **2** was prepared to be a reactive precursor. Silica surface modified benzoxazine **3** was successfully obtained by coupling **2** onto fumed silica. The structural analysis by FT-IR showed characteristic peaks at  $1030\text{ cm}^{-1}$ ,  $1503\text{ cm}^{-1}$ ,  $1489\text{ cm}^{-1}$ , which were assigned to Si-O-Si linkage, oxazine ring, and -C-N-C, respectively.  $^1\text{H-NMR}$  and NOESY  $^1\text{H-NMR}$  studies suggested that the preparation of **2** was successful. Elemental analysis showed that **3** was coupled onto silica surface at the hydroxyl group with the ratio of Si: **2** = 1:20. The ion extraction studies of transition metal ions by using **2**, and **3** showed the same trends, significantly in extraction for  $\text{Pb}^{2+}$ ,  $\text{Cd}^{2+}$ ,  $\text{Zn}^{2+}$ , and  $\text{Mn}^{2+}$ .

## บทคัดย่อ

เขียน ชก เกีย : ซิลิกาเรซินที่ปรับผิวด้วยเบนซอกซาซีนไดเมอร์ด้วยวิธีการผ่าน  
โมโนออกซาซีน (Silica Surface Modified Benzoxazine Dimer via Monooxazine Pathway)  
อ. ที่ปรึกษา ผศ. ดร. สุวบุญ จิรชาญชัย, ศ.ดร. ฮัตซุโอะ อิซิดะ 36 หน้า ISBN 974-334-202-8

สารประกอบไซลิลเบนซอกซาซีน 3,4-dihydro-3-triethoxysilyl-n-propyl-6-methyl-8-  
[(2'-hydroxy-5'-methylbenzyl)cyclohexylaminomethyl]-2H-1,3-benzoxazine 2 ได้ถูกเตรียมขึ้น  
เพื่อเป็นสารตัวกลางที่ว่องไว สารประกอบ 3 ถูกเตรียมจากการตรึง 2 บนผิวพุ่มซิลิกา การ  
วิเคราะห์โครงสร้างด้วย FT-IR พบพีกแสดงถึง Si-O-Si ที่ 1030 เลขคลื่น วงแหวนออกซาซีนที่  
1503 เลขคลื่น และ -C-N-C- ที่ 1489 เลขคลื่น ผลการวิเคราะห์ด้วย  $^1\text{H-NMR}$  และ NOESY  $^1\text{H-NMR}$   
แสดงให้เห็นอย่างชัดเจนว่าเกิดวงแหวนเบนซอกซาซีนเพียงด้านเดียวของไดเมอร์ ในขณะที่  
ผลการประเมินค่าธาตุของสารประกอบ 3 พบว่ามีการตรึงของสารประกอบ 2 บนผิวพุ่มซิลิกา  
ประมาณ 1 โมเลกุลต่อซิลิกา 20 โมเลกุลที่หมู่ไฮดรอกซิล การตรวจสอบสมบัติในการสกัด  
ไอออนพบว่า สารประกอบ 2 และ 3 แสดงความสามารถในการสกัดไอออนที่คล้ายคลึงกัน คือ  
 $\text{Pb}^{2+}$  ได้สูงที่สุด รองลงมาคือ  $\text{Cd}^{2+}$ ,  $\text{Zn}^{2+}$ , และ  $\text{Mn}^{2+}$

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