

**EFFECTS OF Ti AND Nb ON HYDROGEN DESORPTION OF  $Mg(BH_4)_2$**



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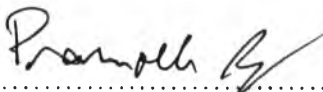
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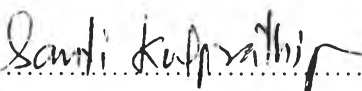
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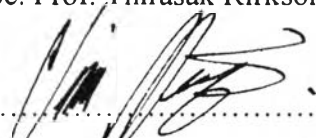
  
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## ABSTRACT

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Wipada Ploysuksai: Effects of Ti and Nb on Hydrogen Desorption of  $\text{Mg}(\text{BH}_4)_2$

Thesis Advisors: Assoc. Prof. Pramoch rangsunvigit and Dr. Santi Kulprathipanja

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In this work, the effects of catalysts (Ti,  $\text{TiO}_2$ ,  $\text{TiCl}_3$ ,  $\text{Nb}_2\text{O}_5$ , and  $\text{NbCl}_5$ ) were investigated on hydrogen desorption of  $\text{Mg}(\text{BH}_4)_2$ .  $\text{LiBH}_4$  and  $\text{MgCl}_2$  with a 2:1 molar ratio were mixed by ball milling to prepare  $\text{Mg}(\text{BH}_4)_2$ . The desorption behaviors were measured by a thermo-volumetric apparatus from room temperature to 450 °C with a heating rate of 2 °C/min. The hydrogen desorption capacity of the mixed sample milled for 2 h was 4.78 wt% with a 2-step release. The first step occurred at 214 °C, and the second step appeared at 374 °C. The addition of 16 wt% catalysts decreased the desorption temperature in the second step by 70 °C except for the Ti catalyst. The addition of  $\text{Nb}_2\text{O}_5$  and  $\text{TiO}_2$  also decreased the desorption temperature in the second step by 70 °C, and the hydrogen desorption capacity to 4.86 wt% and 5.27 wt%, respectively. Furthermore, effects of  $\text{Nb}_2\text{O}_5$  and  $\text{TiO}_2$  loading (10 wt%, 16 wt%, and 20 wt%) were investigated. The results showed that 16 wt% loading exhibited the best performance among all tested catalysts. Hydrogen absorption after desorption of  $\text{Mg}(\text{BH}_4)_2$  was also studied under 9.5 MPa and 350 °C for 12 h.

## บทคัดย่อ

วิภาดา พลอยสุกใส: ผลของตัวเร่งปฏิกิริยาไทเทเนียมและไนโอเบียมต่อพฤติกรรม การคายไฮโดรเจนของแมกนีเซียมโบโรไฮไดรด์ (Effects of Ti and Nb on Hydrogen Desorption of  $Mg(BH_4)_2$ ) อ. ที่ปรึกษา: รศ. ดร. ปราโมช รั้งสรรค์วิจิตร และ ดร. สันต กุลประทีปปัญญา 85 หน้า

งานวิจัยนี้ศึกษาผลของตัวเร่งปฏิกิริยาไทเทเนียม (โลหะไททาเนียม (Ti) ไททาเนียม ไดออกไซด์ ( $TiO_2$ ) และไททาเนียมไตรคลอไรด์ ( $TiCl_3$ )) รวมถึงตัวเร่งปฏิกิริยาไนโอเบียม (ไนโอเบียมเพนตะออกไซด์ ( $Nb_2O_5$ ) และไนโอเบียมเพนตะคลอไรด์ ( $NbCl_5$ )) ต่อพฤติกรรม การคายและอุณหภูมิที่ปลดปล่อยไฮโดรเจนของแมกนีเซียมโบโรไฮไดรด์ [ $Mg(BH_4)_2$ ] โดยใช้ลิเทียมโบโรไฮไดรด์ ( $LiBH_4$ ) และแมกนีเซียมคลอไรด์ ( $MgCl_2$ ) มาบดเชิงกลในอัตราส่วน 2:1 ในการหาปริมาณไฮโดรเจนและอุณหภูมิที่คายของแมกนีเซียมโบโรไฮไดรด์ใช้เครื่องวัด ปริมาตร-อุณหภูมิ โดยอุณหภูมิที่ใช้ในการทดลองเริ่มจากอุณหภูมิห้องถึง 450 องศาเซลเซียส ด้วย อัตราการเพิ่มของอุณหภูมิ 2 องศาเซลเซียสต่อนาที จากการทดลองพบว่า สารผสมลิเทียมโบโร ไฮไดรด์และแมกนีเซียมคลอไรด์ที่บดเชิงกลเป็นเวลา 2 ชั่วโมง คายไฮโดรเจนออกเป็น 2 ช่วง โดยมี ปริมาณไฮโดรเจน 4.78 โดยน้ำหนัก การผสมตัวเร่งปฏิกิริยา 16 เปอร์เซ็นต์โดยน้ำหนัก สามารถ ลดอุณหภูมิการคายในช่วงที่สองได้ 70 องศาเซลเซียส ยกเว้น โลหะไทเทเนียม การผสมไททาเนียม ไดออกไซด์และไนโอเบียมเพนตะออกไซด์สามารถเพิ่มปริมาณไฮโดรเจนเป็น 4.86 และ 5.27 เปอร์เซ็นต์โดยน้ำหนัก ตามลำดับ นอกจากนี้ได้ศึกษาปริมาณการผสมไททาเนียมไดออกไซด์และ ไนโอเบียมเพนตะออกไซด์ต่อพฤติกรรมการคายและอุณหภูมิที่ปลดปล่อยไฮโดรเจน โดยใช้ ปริมาณตัวเร่งปฏิกิริยาในช่วงจาก 10 ถึง 20 เปอร์เซ็นต์โดยน้ำหนัก พบว่า ปริมาณตัวเร่งปฏิกิริยาที่ 16 เปอร์เซ็นต์โดยน้ำหนัก ให้ผลการคายไฮโดรเจนดีที่สุด และมีการทดลองการดูดซับไฮโดรเจน หลังจากการคายซ้ำที่ความดัน 9.5 เมกะปาสกาล และอุณหภูมิ 350 องศาเซลเซียส เป็นเวลา 12 ชั่วโมง

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