MODIFICATION OF LITHIUM BOROHYDRIDE AND MAGNESIUM HYDRIDE MIXTURE FOR HYDROGEN STORAGE

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บทคัดย่อ

ภัทรพร ศรีเดชประสาท : การปรับปรุงสารผสมระหว่างลิเทียมบอรอไฮไดรด์และแมกนีเซียมไฮไดรด์ สำหรับการกักเก็บก๊าซไฮโดรเจน (Modification of Lithium Borohydride and Magnesium Hydride for Hydrogen Storage) อ. ที่ปรึกษา : รศ. ดร. ปราโมช รังสรรค์วิจิตร ดร. สันติ กุลประทีปัญญา และ ผศ. ดร. บุนยรัชต์ กิติยานันท์ 130 หน้า

งานวิจัยนี้ศึกษาคุณสมบัติการปลดปล่อย/ดูดซับก๊าซไฮโดรเจนของสารผสมระหว่างลิเธียมบอรอไฮไดรด์และแมกนีเซียมไฮไดรด์ ในอัตราส่วน 2:1 โดยโมล (สารผสม) คุณสมบัติที่ตรวจสอบครอบคลุม อุณหภูมิของการปลดปล่อย กลไกการเกิดปฏิกิริยา และการผันกลับได้ ในการศึกษาส่วนแรก เป็นการศึกษากลไกของการปลดปล่อย/ดูดซับก๊าซไฮโดรเจนของสารผสมที่ผ่านการบดเป็นเวลา 1 ชั่วโมง ผลการทดลองแสดงให้เห็นว่า ที่อุณหภูมิต่ำกว่า 400 องศาเซลเซียส เกิดการปลดปล่อยก๊าซไฮโดรเจนบางส่วนจากลิเทียมบอรอไฮไดรด์และแมกนีเซียมไฮไดรด์ ในขณะที่อุณหภูมิ 450 องศาเซลเซียส เกิดการก่อตัวของแมกนีเซียมไดบอไรย์และลิเทียมไฮไดรด์ จากนั้นได้ศึกษาผลของการเติมไททาเนียมไตรคลอไรด์ ฮาฟเนียมเตตระคลอไรด์ และเซอร์โคเนียมเตตระคลอไรด์ ในปริมาณร้อยละ 3 โดยโมล ลงไปในสารผสม ในการศึกษาส่วนที่สอง ได้ศึกษาผลกระทบของเวลาในการบดต่อพฤติกรรมการปลดปล่อย/ดูดซับก๊าซไฮโดรเจนของสารผสม ซึ่งพบว่าเมื่อเพิ่มเวลาของการบด อุณหภูมิและปริมาณของก๊าซไฮโดรเจนที่ปลดปล่อยออกมาลดลง สำหรับการศึกษาในส่วนที่สาม นั้นได้เติมตัวเร่งปฏิกิริยาไททาเนียม ไททาเนียมไดออกไซด์ และไททาเนียมไตรคลอไรด์ ลงไปในสารผสมและบดเป็นเวลา 5 ชั่วโมง ผลการศึกษาแสดงให้เห็นว่า การเติมไททาเนียม ให้ปริมาณก๊าซไฮโดรเจนที่ปลดปล่อยออกมาจากสารผสมสูงสุดที่ร้อยละ 5.0 โดยน้ำหนัก ในการศึกษาส่วนที่สี่ เป็นการศึกษาผลกระทบของความดันเริ่มต้นต่อการกักเก็บก๊าซไฮโดรเจนของสารผสมที่ผ่านการบดเป็นเวลา 5 ชั่วโมง จากผลการทดลองพบว่า สารผสมที่สลายตัวภายใต้ความดันก๊าซไฮโดรเจนเริ่มต้น 0.15 เมกะพาสคาล ปลดปล่อยก๊าซไฮโดรเจนออกมาสูงสุดที่ร้อยละ 5.0 โดยน้ำหนัก

ABSTRACT

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In this work, $LiBH_4$ was mixed with magnesium hydride (MgH_2) in a 2:1 molar ratio (mixture) in order to investigate the hydrogen desorption/absorption properties. In the first part, the mixture milled for 1 h was observed for its hydrogen desorption/absorption mechanism. The results showed that, when the temperature was lower than 400°C, the released hydrogen was from the partial decomposition of $LiBH_4$ and MgH_2. At 450°C, there was the formation of MgB_2 and LiH. 3 mol% of $TiCl_3$, $HfCl_4$, and $ZrCl_4$ was also added into the mixture. It was found that all the catalyzed mixtures had lower desorption temperatures. The effects of ball-milling time on the hydrogen desorption/absorption behaviors of the mixture were studied in the second part. It was found that the increase in the ball-milling time resulted in the decrease in the desorbed temperature as well as the hydrogen capacity. In the third part, Ti, TiO_2, and $TiCl_3$ were added into the mixture and milled for 5 h. The results showed that doping with Ti resulted in the highest amount of hydrogen, 5.0 wt%, released from the mixture. In the fourth part, the effects of initial pressure on the hydrogen storage properties of the mixture milled for 5 h were investigated. The results exhibited that the mixture decomposing under 0.15 MPa hydrogen had the highest reversible hydrogen capacity of 5.0 wt%.

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