

STUDY ON THE IMPROVEMENT OF HYDROGEN STORAGE
PROPERTIES, MICROSTRUCTURE, AND ACTIVATION
ENERGY OF 10 wt% SrTiO₃-DOPED WITH
MgH₂ + Na₃AlH₆ COMPOSITE FOR
SOLID STATE HYDROGEN
STORAGE

LEW WOON BING

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SCHOOL OF OCEAN ENGINEERING
UNIVERSITI MALAYSIA TERENGGANU
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-DOPED WITH MgH₂ + Na₃AlH₆ COMPOSITE FOR SOLID STATE
HYDROGEN STORAGE

By

LEW WOON BING

Thesis submitted in partial fulfilment of the
requirement for the award of the degree of
Bachelor of Applied Science (Electronics and Instrumentation Physics)

SCHOOL OF OCEAN ENGINEERING
UNIVERSITI MALAYSIA TERENGGANU
2018

THESIS CONFIRMATION AND APPROVAL

This is acknowledged and confirmed that thesis entitled: Study on the Improvement of Hydrogen Storage Properties, Microstructure, and Activation Energy of 10 wt% SrTiO₃-Doped With MgH₂ + Na₃AlH₆ Composite for Solid State Hydrogen Storage by LEW WOON BING. Matric No.: S39179 have been checked and all the suggested corrections have been done. The thesis is submitted to School of Ocean Engineering, Universiti Malaysia Terengganu in partial fulfillment of the requirements for the award of the degree of Bachelor of Applied Science (Electronics and Instrumentation Physics).

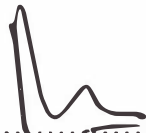
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DECLARATION

I hereby declare that this thesis is the result of my own research except as cited in the references.

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Matric No. : S39179

Date : 1/6/2018

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**STUDY ON THE IMPROVEMENT OF HYDROGEN STORAGE
PROPERTIES, MICROSTRUCTURE, AND ACTIVATION ENERGY OF 10
wt% SrTiO₃-DOPED WITH MgH₂ + Na₃AlH₆ COMPOSITE FOR SOLID
STATE HYDROGEN STORAGE**

ABSTRACT

In this study, the hydrogen storage properties of 10 wt% SrTiO₃ added to MgH₂ + Na₃AlH₆ were investigated for the first time. MgH₂ + Na₃AlH₆ doped with SrTiO₃ exhibited an improvement on the onset dehydrogenation temperature and isothermal de/rehydrogenation kinetics compared with the un-doped MgH₂ + Na₃AlH₆ composite. The X-ray diffraction result for the MgH₂ and Na₃AlH₆ had confirmed that the samples do not have any impurity as no other peak was detected. Besides, the X-ray diffraction patterns also showed that SrTiO₃ did not decompose throughout the heating processes. Meanwhile, result from the pressure-composition-temperature showed that the initial desorption temperature of the doped composite was lowered by 20°C and the hydrogen absorption and desorption capacity were improved around 1.15 wt% and 0.4 wt%, respectively. The Kissinger analysis demonstrated that the apparent activation energy of the composite was reduced from 129.7 kJ/mol to 117.1 kJ/mol after doped with SrTiO₃. Meanwhile, the scanning electron microscope results proved that the composite with the additive of SrTiO₃ showed the smallest particle sizes compared to the un-doped composite. In conclusion, the hydrogen storage properties of MgH₂ + Na₃AlH₆ were improved with the addition of the SrTiO₃ additive.

**KAJIAN TERHADAP PENINGKATAN CIRI-CIRI PENYIMPANAN
HIDROGEN, STRUKTUR MIKRO DAN TENAGA PENGAKTIFAN BAGI
PENYIMPANAN HIDROGEN PEPEJAL $MgH_2 + Na_3AlH_6$ YANG DITAMBAH
DENGAN 10 wt% $SrTiO_3$**

ABSTRAK

Dalam kajian ini, ciri-ciri penyimpanan hydrogen bagi $MgH_2 + Na_3AlH_6$ yang ditambah dengan 10 wt% $SrTiO_3$ pemangkin telah dikaji buat kali pertama. $MgH_2 + Na_3AlH_6$ yang ditambahkan dengan $SrTiO_3$ memperlihatkan peningkatan dalam suhu permulaan dehidrogenasi dan hidrogenasi dan dehidrogenasi kinetika isoterma berbanding komposit $MgH_2 + Na_3AlH_6$ asal. Hasil daripada difraksi sinar-X untuk MgH_2 dan Na_3AlH_6 telah mengesahkan bahawa sampel tidak mempunyai sebarang bendasing kerana tiada puncak lain yang dikesan. Selain itu, corak difraksi sinar-X juga menunjukkan bahawa $SrTiO_3$ tidak terurai sepanjang proses pemanasan. Sementara itu, hasil daripada kajian suhu-komposisi-tekanan menunjukkan bahawa suhu penyerapan awal komposit yang dicampurkan pemangkin telah diturunkan sebanyak $20^\circ C$ dan kapasiti penyerapan dan pelepasan hydrogen meningkat sekitar 1.15 w% dan 0.4 w%. Analisis Kissinger menunjukkan bahawa tenaga pengaktifan komposit dikurangkan dari 129.7 kJ/mol kepada 117.1 kJ/mol selepas ditambah dengan $SrTiO_3$. Sementara itu, hasil pengimbasan mikroskop elektron membuktikan bahawa komposit dengan bahan tambahan $SrTiO_3$ menunjukkan saiz zarah terkecil berbanding dengan komposit yang tidak dicampurkan pemangkin. Sebagai kesimpulan, ciri-ciri penyimpanan hydrogen bagi $MgH_2 + Na_3AlH_6$ telah diperbaiki dengan penambahan pemangkin $SrTiO_3$.