Sirindhorn International Institute of Technology

Thammasat University

Thesis ChE-MS-2009-01

THE DEVELOPMENT OF NOVEL CATALYST FOR METHANOL STEAM REFORMING

Suparoek Henpraserttae

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A Thesis Presented

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Suparoek Henpraserttae

Master of Engineering
Engineering Technology Program
Sirindhorn International Institute of Technology
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October 2009

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Suparoek Henpraserttae

Submitted to
Sirindhorn International Institute of Technology
Thammasat University
In partial fulfillment of the requirement for the degree of
MASTER OF ENGINEERING (ENGINEERING TECHNOLOGY)

Approved as to style and content by the Thesis Committee:

Chair and Advisor _____
Pisanu Toochinda, Ph.D.

Co-Advisor _____
Pimpa Limthongkul, Ph.D.

Member _____
Assoc. Prof Luckhana Lawtrakul, Dr.rer.nat.

Member _____
Asst. Prof. Pakorn Opaprakasit, Ph.D.

External Examiner: Sumittra Charojrochkul, Ph.D.

October 2009

Acknowledgment

I would like to thank Dr. Pisanu Toochinda, my adviser, for his advice and his precept. I would like to thank Dr. Pimpa Limthongkul from National Metal and Materials Technology Center (MTEC), my co-adviser and my supervisor at MTEC, for her support in this study and always gave me a good suggestion. I also thank Miss Suphakan Kijamnajsuk at MTEC for SEM characterization. I am grateful to the thesis committee member, Assoc. Prof. Dr. Luckhana Lawtrakul and Asst. Prof. Dr. Pakorn Opaprakasit, for their valuable comment to improve the quality of this thesis. My appreciation is also expressed to Dr. Sumittra Charojrochkul from MTEC for Thesis examination. I am grateful to MTEC and SIIT for providing the scholarship and research facilities. I really thank to Miss Pimpun Moolwong for her morale throughout this study. I also thank my friends in School of Bio and Chemical Engineering Technology at SIIT for helping me everything in this study. All of the officers at SIIT are also gratefully acknowledged. Finally, my deep gratitude is acknowledged to my parents.

Abstract

A novel catalyst for hydrogen production from the catalytic methanol reforming process could play an important role in hydrogen production to be used as a feed for a fuel cell. This study focuses on the preparation methods of Cu/Zn based catalysts with and without using urea by incipient wetness impregnations to study the efficiency of the impregnated catalysts. The catalytic methanol reforming was studied in a fixed-bed reactor under mild conditions. The activity in the hydrogen production of the impregnated catalysts and a commercial catalyst was analyzed by gas chromatograph and compared in terms of hydrogen production yield. An impregnated Cu-Zn over Al_2O_3 exhibits the high activity with the use of a lower amount of active metal relative to conventional co-precipitation catalysts. The activity of catalyst could be enhanced by the addition of urea in metal salt solution during the impregnation. The H_2 yield from the impregnated catalysts treated with urea (CZU) is 42% while the H_2 yield from the impregnated catalyst without urea treated (CZ) is only 28% in continuous system at 250 °C. The H_2 yield of the impregnated catalyst treated with urea in this study can compete with that of commercial catalyst. The role of urea in the impregnated catalyst was investigated. The XRD diffractogram of catalyst shows that the crystallite size of CuO can be reduced by the addition of urea. The XRD diffractogram of the impregnated catalyst treated with urea before calcination process also shows the formation of NH_4NO_3 which could aid in dissociation of Cu-Zn compounds clusters. The SEM images of catalysts show a size of Cu-Zn compounds clusters and also dispersion of Cu-Zn compounds clusters over Al_2O_3 on the impregnated catalysts. The addition of urea in the catalyst preparation can also yield the smaller Cu-Zn compounds cluster and better dispersion over the impregnated catalyst without urea added. The impregnated catalysts can exhibit activity at as low a temperature as 453 K which indicates the possibility of lowering the reaction temperature for the methanol reforming process. The impregnated Cu-Zn catalyst treated with urea could be alternative novel catalyst for methanol steam reforming with a lower cost of the catalyst compared with the co-precipitation method used commercially.

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