CHAPTER V
CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

In this research, two types of TiO_2 photocatalyst, namely synthesized mesoporous-assembled TiO_2 without and with Pt loading and commercial non-mesoporous-assembled TiO_2 (P-25 TiO_2, ST-01 TiO_2, JRC-01 TiO_2, and JRC-03 TiO_2), were comparatively used for photocatalytic H_2 production under visible light irradiation from 150 ml aqueous diethanolamine (DEA) solution containing dissolved Eosin Y (E.Y.) sensitizer. The mesoporous-assembled TiO_2 photocatalyst was synthesized by the sol-gel process with the aid of a structure-directing surfactant, whereas the Pt-loaded mesoporous-assembled TiO_2 was synthesized by the single-step sol-gel method, by using TIPT as Ti precursor modified with ACA agent and LAHC as structure-directing surfactant to control the porosity. The results of N_2 adsorption-desorption analysis revealed that the isotherms of the unloaded mesoporous-assembled TiO_2 and 0.6 wt.% Pt-loaded mesoporous-assembled TiO_2 nanocrystals calcined at 500°C for 4 h showed typical IUPAC type IV pattern, indicating that the synthesized TiO_2 photocatalysts possessed mesoporous structure (mesopore size between 2-50 nm). On the other hand, the isotherms of the commercial P-25 TiO_2, ST-01 TiO_2, JRC-01 TiO_2, and JRC-03 TiO_2 photocatalysts corresponded to IUPAC type II pattern, suggesting that all of commercial TiO_2 photocatalysts possessed non-mesoporous structure.

To employ the TiO_2 photocatalysts under visible light irradiation, sensitizer addition and Pt loading were performed. For the sensitization, the selected E.Y. sensitizer could mainly absorb the visible light with the maximum absorption centered at 516 nm. This absorption feature strongly suggests that the sensitizer can be activated by visible light for the sensitized photocatalytic hydrogen production system in this study. Moreover, the well-balanced combination between E.Y. sensitizer and DEA could enhance the photosensitized hydrogen production. The experimental results revealed that the 0.6 wt.% Pt-loaded mesoporous-assembled TiO_2 calcined at 500°C for 4 h exhibited the highest photocatalytic performance for

hydrogen production from the 150 ml aqueous 30 vol.% DEA/distilled water solution containing dissolved 2 mM E.Y. sensitizer with the photocatalyst dosage of 3.33 g/l and initial solution pH of 11.5, as the optimum conditions.

5.2 Recommendations

To prevent electron-hole recombination, deposition of noble metals has been reported to expedite electron transfer to outer surface for the hydrogen production. In addition to the most investigated Pt, the others, such as Au and Ru, are also interesting since they are more cost-effective. Moreover, bimetallic noble metals, such as Pt-Au and Pt-Ru, should be examined.

In order to further improve the photocatalytic hydrogen production performance, other types of electron donor and sensitizer should also be applied for the reaction.