CHAPTER V
CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

In this research, types of perovskite photocatalysts, namely the synthesized mesoporous-assembled $MgTiO_3$, $CaTiO_3$, and $SrTiO_3$ photocatalysts, the synthesized 0.5 wt.% Pt-loaded mesoporous-assembled $SrTiO_3$ photocatalyst, and the commercial $SrTiO_3$ and P-25 TiO_2 photocatalysts were comparatively used for the photocatalytic H_2 production under visible light irradiation from aqueous DEA or TEA solution containing dissolved E.Y. sensitizer. All the mesoporous-assembled perovskite photocatalysts were synthesized by the sol-gel process with the aid of a structure-directing surfactant, whereas the Pt-loaded mesoporous-assembled $SrTiO_3$ photocatalyst was synthesized by the single-step sol-gel method, by using TIPT as the Ti precursor modified with the ACA agent and the LAHC as the structure-directing surfactant to control the porosity. The results of N_2 adsorption-desorption analysis revealed that the isotherms of the mesoporous-assembled $MgTiO_3$, $CaTiO_3$, $SrTiO_3$ photocatalysts, and the 0.5 wt.% Pt-loaded mesoporous-assembled $SrTiO_3$ photocatalyst calcined at 500, 550, 650, and 650°C, respectively, showed typical IUPAC type IV-like pattern, indicating that the synthesized perovskite photocatalysts possessed mesoporous structure (mesopore size between 2 and 50 nm). On the other hand, the isotherms of the commercial $SrTiO_3$ and P-25 TiO_2 photocatalysts corresponded to IUPAC type II pattern, suggesting that the commercial photocatalyst possessed non-mesoporous structure.

To employ the synthesized perovskite photocatalysts under visible light irradiation, sensitizer addition and Pt loading were performed. For the sensitization, the selected E.Y. sensitizer could mainly absorb visible light with the maximum absorption centered at 516 nm. This absorption feature strongly suggested 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 electron donor could enhance the photosensitized hydrogen production. The experimental results revealed that the synthesized 0. 5 wt.% Pt-

loaded mesoporous-assembled $SrTiO_3$ photocatalyst calcined at 650°C for 4 h exhibited the highest photocatalytic performance for hydrogen production from the 150 ml aqueous 15 vol.% DEA aqueous solution containing dissolved 0.5 mM E.Y. sensitizer with a photocatalyst dosage of 6 g/l and an initial solution pH of 11.6, as the optimum conditions.

5.2 Recommendations

To prevent electron-hole recombination, deposition of noble and transition 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 Ni and Cu, are also interesting since they are more cost-effective.

In order to further improve the photocatalytic hydrogen production economy, various sensitizers naturally extracted from indigenous vegetables and flowers, such as blue pea, rosella, and red cabbage, should also be applied for the photocatalytic reaction instead of the synthetic sensitizer.