



CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

In this research, the mesoporous-assembled TiO_2 and $\text{TiO}_2\text{-ZrO}_2$ mixed oxide photocatalysts without and with Pt loading were synthesized by the sol-gel process with the aid of a structure-directing surfactant and were comparatively used for sensitized photocatalytic H_2 production under visible light irradiation from aqueous diethanolamine (DEA) solution containing dissolved Eosin Y (E.Y.) sensitizer. The Pt-loaded mixed oxide photocatalysts were synthesized by both the single-step sol-gel (SSSG) and photochemical deposition (PCD) methods.

The modification of TiO_2 with ZrO_2 had an effect on the photocatalyst physicochemical properties and photocatalytic activity. The addition of the secondary ZrO_2 phase could effectively stabilize the mesoporous structure of the TiO_2 during a more severe thermal treatment up to $800\text{ }^\circ\text{C}$, indicating high thermal stability. The modification also maintained the high surface areas after the calcination and inhibited the anatase-to-rutile phase transformation at higher temperature around $800\text{ }^\circ\text{C}$.

For the sensitized photocatalytic activity, the experimental results revealed that without Pt loading, the $\text{TiO}_2\text{-ZrO}_2$ photocatalyst with a Ti-to-Zr molar ratio of 95:5 calcined at $800\text{ }^\circ\text{C}$ for 4 h provided the maximum photocatalytic hydrogen production activity. Moreover, the 0.5 wt.% Pt loading on the $0.95\text{TiO}_2\text{-}0.05\text{ZrO}_2$ mixed oxide photocatalyst and prepared by the PCD method was found to enhance the photocatalytic activity of the mixed oxide photocatalyst more than that by the SSSG method. Moreover, the UV light irradiation time of 2 h and UV light intensity of 44 W were considered as the most suitable conditions used in the PCD method.

5.2 Recommendations

In order to obtain higher thermal stability of TiO_2 , other metal oxides, e.g. SiO_2 , can also be interestingly used to incorporate to the synthesized meso-assembled TiO_2 for this photocatalytic H_2 production application. The immobilization of the thermally-stable mixed oxide photocatalysts should also be studied for this application in order to imitate the real application.