CHAPTER V
CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

In this research, two types of TiO_2 photocatalyst, synthesized mesoporous TiO_2 and commercial Degussa P-25 TiO_2, were comparatively used for photocatalytic H_2 evolution under visible light irradiation in a form of N-doped TiO_2. The mesoporous TiO_2 photocatalyst was synthesized by surfactant-assisted tempting sol-gel method by using TIPT as Ti precursor modified with ACA agent and LAHC as surfactant template to control its porosity. The results of N_2 adsoption-desorption analysis revealed that the isotherm of the synthesized TiO_2 photocatalyst showed typical IUPAC type IV pattern, indicating that the synthesized TiO_2 photocatalyst possessed mesoporous structure (mesopore size between 2-50 nm). On the other hand, the isotherm of the commercial Degussa P-25 TiO_2 showed typical IUPAC type II pattern, suggesting that the commercial Degussa P-25 TiO_2 possessed non-mesoporous structure. To modify the visible light absorption ability of TiO_2 photocatalyst, N-doping onto TiO_2 photocatalyst was performed. This resulted in the reduction of the band gap of the TiO_2 photocatalysts. Therefore the TiO_2 photocatalysts could subsequently absorb visible light ($\lambda > 400$ nm). The urea as a source of N was mixed with the TiO_2 photocatalysts at various urea:TiO_2 molar ratios and calcined at various calcination temperatures. The optimum preparation conditions of the N-doped mesoporous and Degussa P-25 TiO_2 were the urea:TiO_2 molar ratio of 1:1 at calcination temperature of 250°C and 0.5:1 at calcination temperature of 250°C, respectively. However, the N-doped mesoporous TiO_2 prepared at such the optimum condition exhibited the best H_2 evolution activity. To improve the photocatalytic H_2 evolution activity, Pt was loaded onto this N-doped mesoporous TiO_2 by incipient wetness impregnation (IWI) method. The optimum Pt loading content was 1.3 wt%, providing the highest photocatalytic H_2 evolution activity. It was clearly found that the surface Pt content greatly influenced on the H_2 evolution activity.

5.2 Recommendations

For modification of visible light absorption ability of the mesoporous TiO_2 photocatalyst, many techniques can be applied. The use of sensitizer is another potential technique, which can effectively modify the TiO_2 photocatalyst to be able to respond to visible light. Because the sensitizer can directly absorb visible light by itself and generate excited electron to transfer to the conduction band of TiO_2 and subsequently reduce water to hydrogen, the photocatalytic H_2 evolution can be achieved.

To prevent electron-hole recombination, deposition of noble metals has been investigated to expedite electron transfer to outer surface. In addition to the most investigated Pt, the others such as Au, Pd, Rh, Ni, Cu, and Ag are also interesting since they are more cost-effective.