CHAPTER VIII
CONCLUSIONS AND RECOMMENDATIONS

8.1 Conclusions

Pristine and metal-loaded mesoporous-assembled $SrTiO_3$ nanocrystal photocatalysts were successfully synthesized via the single-step sol-gel method with the aid of a structure-directing surfactant using EtOH as a solvent, LAHC as a structure-directing surfactant with an LAHC-to-TIPT molar ratio of 0.25:1, the calcination temperature of 700°C with a heating rate of 1°C min^{-1}, and 4 h calcination time. This synthesis method provided the mesoporous-assembled $SrTiO_3$ nanocrystal photocatalysts with high purity, high crystallinity, high homogeneity, very narrow and monomodal pore size distribution, and low specific surface in the range of 8-12 m^2 g^{-1}.

The mesoporous assembly of the synthesized $SrTiO_3$ nanocrystals was found to be responsible for the enhancement in the photodegradation of methyl orange and the photocatalytic hydrogen production via the water splitting. Loading of some metals (such as Au, Pt, Ni, and Ag) as the co-catalyst was found to enhance the photocatalytic hydrogen production activity of the mesoporous-assembled $SrTiO_3$ photocatalyst. The enhancement of the photocatalytic hydrogen production activity was found to depend on the electrochemical properties of the loaded metal and its loading. Au was found to be the most suitable loaded metal for the hydrogen production from the photocatalytic water splitting over the mesoporous-assembled $SrTiO_3$-based photocatalysts and the optimum Au loading was 1 wt.%. The performance of photocatalytic hydrogen production were also found to depend on other important factors including the photocatalyst dosage, the reaction temperature, the pH of the solution, the hydrogen diffusability from the liquid phase into the gas phase, and the type and concentration of the hole scavenger.

8.2 Recommendations

The loaded metal co-catalyst that presented on the $SrTiO_3$ photocatalyst surface was more benefit for photocatalytic activity enhancement than that of presented in the bulk of $SrTiO_3$ photocatalyst. The other loading techniques, such as photodeposition, chemical deposition, and impregnation, should be applied for the metal-loaded mesoporous-assembled $SrTiO_3$ nanocrystal photocatalyst synthesis to find out the most effective loading technique.

The presence of a small molecule organic compound, such as methyl alcohol, ethyl alcohol, formic acid, and acetic acid, was found to enhance the hydrogen production efficiency of the photocatalytic water splitting reaction. This can point out that the hydrogen production with simultaneous elimination of water soluble organic pollutants is possible.

The increase in the hydrogen diffusability from the liquid phase into the gas phase resulted in the increase in the photocatalytic hydrogen production efficiency. The micro-reactors, which possibly provide the high diffusability, is a promising technique that can be applied for the hydrogen production via the photocatalytic water splitting.