# CONCLUSIONS AND RECOMMENDATIONS

## Conclusions

The following conclusion can be drawn from this study:

1. Increasing $TiO_2$ film thickness increases sunlight conversion efficiencies of electrochemical photocells (EPC). In this experiment, electrodes of group D (3-4 μm) are more efficient than group A (~1 μm)
2. By increasing intensities of sunlight, the photocurrent and rates of hydrogen evolution in EPC increase in the range about 40 $mW/cm^2$ to 80 $mW/cm^2$.
3. For the voltage-biased EPC, the conversion efficiency is strongly dependent on the mangnitude of the bias voltage, as the experimental results indicate the maximum bias voltage is about 0.5-0.6 volts.
4. The effect of stirring the solution of catholyte is a slight increase in the efficiency of EPC.
5. In biased EPC by a 0.5 V solar cell, the rates of hydrogen evolution increase but the conversion efficiencies equal the no-bias photocells.
6. The proper $TiO_2$ area/Pt area ratio may be a considerable parameter of an efficient photocell for hydrogen production.
7. The gold electrode for EPC gives lower conversion efficiencies than the platinum cathode electrode.

## Recommendations

There are so many detailed information of theories and applications of solar cells and electrolysis cells, which were described and collected in this study. Because the basic approach of this photoelectrochemical

study in necessary to understand the fundamental principles of semiconductor in photoelectronic fields and electrochemistry. From the literature of photoelectrochemical cells for sunlight conversion to electrical or chemical energy, the investigations are both the tasks of electrical engineers and chemical engineers doing research and development in this field. Therefore in Chapter III and IV, the detailed information is useful for other researchers who would like to pursue and investigate this new field. The photoelectrochemical cell is a new device for chemical engineers in solar energy. Thus this research is a primary study and also introduces the device to chemical engineers.

From the results of this experimental study, the following recommendations are suggested:

1. $TiO_2$ thin film coating by direct heating, an instrument should be designed for the uniform distribution of fire from the gas burner and some techniques for the heating process should be devised.

2. The $TiO_2$ thin film on Ti-sheet substrates should be developed by doping transition metals (e.g. Al, Cr, Fe) or lanthanium (La) to the photoanode, it may increase the conversion efficiencies as the $TiO_2$ crystal electrode.