

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

In the preparation of TiO₂ thin film on glass plate using sol-gel technique, the properties of TiO₂ thin film were strongly influenced by the preparation conditions. The mole ratio of alkoxide to alcohol, acidic catalyst, additive substance, calcination temperature, and coating cycles were the major parameters to be controlled. The photocatalytic reactivity of the obtainable thin film was also studied. It has been found that the difference in photocatalytic reduction of Cr(VI) could be correlated with the structure morphology of the thin film. For example, the thin film obtaining from 500°C calcination temperature provides the highest efficiency in Cr(VI) removal due to the highest amount of anatase in the thin film composition. Coating cycle also showed an important effect on the film properties.

The results of preparation of TiO₂ thin film using sol-gel technique can be concluded in the following aspects:

5.1.1 The concentration of ethanol strongly affected on amount of TiO₂ film. At the less concentration of ethanol, thin film showed the highest amount of TiO₂, which tend to decrease as the concentration of ethanol increases. Ethanol not only affected on amount of TiO₂ but also affected on the intensity of anatase peak. The optimum ratio of titanium(IV) butoxide : ethanol was obtained at 1:30.

5.1.2 HCl acid, which was employed as acidic catalyst, had an effect on the film surface. When high amount of HCl was applied, more smoothness and fewer cracks of TiO₂ films were acquired. The optimum ratio of titanium(IV) butoxide : ethanol : HCl obtained at 1:30:0.5.

5.1.3 Acetylacetone played an important role on the film surface. Since it was used as stabilizing agent in the sol preparations that lead to good quality of the film surface which are uniform, compact and less crack. As a result of the consistent anatase peak, acetylacetone had no effect on the crystal structure of TiO_2 film. The optimum ratio of titanium(IV) butoxide : ethanol : HCl : acetylacetone was carried out at 1:30:0.5:1.

5.1.4 At the optimum condition of sol preparation, effects of calcination temperature on the film property were investigated. Calcination temperature affected on film surface and formation of anatase crystal. With the increasing of calcination temperature, more shrinkage and more cracks were obtained. Moreover, the increasing in intensity of anatase peak was also attained, probably enhance the photocatalytic reduction of Cr(VI). The thin film calcined at 500°C provides the highest efficiency in Cr(VI) removal.

5.1.5 As the investigation of coating cycles, the film thickness and amount of anatase depended upon the number of coating cycles. Additional, the efficiencies in Cr(VI) removal were also resulted in the increasing of coating cycles. The TiO_2 thin film with 3 coating cycles exhibits the highest efficiency in Cr(VI) removal.

In conclusion, the optimum condition for glass- TiO_2 thin film prepared using sol-gel technique was mole ratio of 1:30:0.5:1 as calcination temperature of 500°C and coating cycles of 3 films. The results from this research can be the fundamental information of TiO_2 thin film preparation for environmental application.

5.2 Recommendations

The recommendations are aimed toward improvement of the preparation of TiO_2 thin film. TiO_2 thin film with practical properties could be applicable for further research development for the real situation. The suggestions obtained from this study were shown as follows:

5.2.1 The parameters influencing the property of TiO_2 thin film such as type of substrate, withdrawn speed and calcination times should be investigated.

5.2.2 Other types of inorganic and organic substance should be employed as tested pollutants.

5.2.3 The optimum conditions obtained from this work could be applied for full-scale photocatalysis reactor.

5.2.4 In application of TiO_2 thin film for photocatalysis process in the real situations which have various Cr(VI) concentration containing, the reaction rate constant obtained from this work is beneficial for forecast of removal behavior.