CHAPTER 4

CONCLUSIONS

4.1 Synthesis of TiO_2 and acid-modified TiO_2 by Thermal hydrolysis, characterization and its application as a photocatalyst

Titanium dioxide (TiO_2) and acid-modified TiO_2 were successfully synthesized by hydrolysis of titanyl sulfate ($TiOSO_4$). TiO_2 and TiO_2 modified with carboxylic acid calcination at 600 ^oC for 3h produced anatase titania, whereas the TiO_2 calcined at 900 ^oC showed a rutile phases. The phase composition of TiO_2 modified by carboxylic acid was not changed in comparison with the unmodified TiO_2 at the same condition. Crystallinity of the TiO_2 was enhanced upon increasing calcination temperature. At high thermal treatment temperature, the increase of crystal size upon high thermal treatment also accompanied with a significant decrease of BET specific surface area. However, the TiO_2 modified by cinnamic acid (CA) provided higher crystallite size compared with unmodified TiO_2. Increasing the mole ratio of cinnamic acid:Ti resulted in the enhancement of crystallite sizes and specific surface area of the samples. TiO_2 modified by benzoic acid (BA) provided the highest surface area compared with that from salicylic acid (SA) and cinnamic acid (CA). SEM images indicated that TiO_2 and TiO_2 modified with carboxylic acid were agglomerated irregular primary particles. The average size of TiO_2 and TiO_2 modified by cinnamic acid (CA) were found to be 16-22 and 6-20 nm, respectively. The loading amount of CA has no significant effect on the particle size. UV-vis DRS result of TiO_2 calcined at 600 ^oC had strong UV-light absorption which suggested the

great potential for use as a highly efficient photocatalyst. The IR peak of TiO_2 calcined at 300-600 ^oC and TiO_2 modified by carboxylic acid at 462 cm^{-1} were a contribution from the anatase TiO_2. The sulphate group from the Ti precursor was decreased upon calcination above 500 ^oC 3h. The IR results of TiO_2 modified by carboxyliac acid indicated that carboxylate groups complexed with surface Ti atoms. The binding form of carboxylic acids on the TiO_2 nanoparticles in all samples was bidentate chelating type. Zeta potential result indicated that the surface charge of TiO_2:BA in 1:1 ratio was neutral at the pH of photocatalytic study (pH 7) whereas those of TiO_2:SA and TiO_2:CA were negative. Since at this pH phenol was in the form of non-dissociation which has neutral charge, therefore phenol would preferably bind with the TiO_2:BA surface resulting in high photocatalytic degradation.

4.2 Suggestions for future work

Study on the photocatalytic degradation of phenol derivatives over TiO_2:acid should be investigated.