CHAPTER 4

Conclusion

The enhanced photocatalytic activity of visible light-driven catalyst is successfully improved by coupling between Ag_3VO_4 and $CoTiO_3$ via hydrothermal method. SEM shows rod like morphology of $CoTiO_3$ in micro-scale, while Ag_3VO_4 particles appears as agglomerated irregular shape. The close interfacial interaction between both phases is illustrated by TEM images. It was found that 50 wt% $Ag_3VO_4/CoTiO_3$ shows the highest photoactivity in MB degradation reaction.

The band alignment of hybrid system is investigated by UV-vis DRS and XPS to estimate the band gap energy and energy level of valence band of constituents, respectively. This coupling system is considered as a type II of heterostructure, in which the conduction band of the smaller band gap component staggers the larger band gap component. Therefore, the improved photoactivity can be described by the efficient charge transfer according to the appropriate band lineup. With this band lineup, the electron-hole pairs are effectively separated to react with oxygen, water or hydroxide ion to further produce active species which are used in the degradation process of MB. It can be obviously seen in PL study that fluorescence emission by electron-hole recombination process is significantly reduced in the composite, indicating an efficient charge transfer. Correspondingly, the fluorescence emission of 2-hydroxyterephthalic acid that is proportional to the amount of hydroxyl radical shows high intensity in the coupling system compared with individual materials. It can be concluded that composite produces more active species in the system which increases the degradation reaction.

Although, $CoTiO_3$ is less active in MB degradation owing to its high recombination process as seen in PL spectra, $CoTiO_3$ plays an important role in enhanced photoactivity. $CoTiO_3$ can absorb light in two main region which are below 500 nm and in the range of 500-700 nm, while Ag_3VO_4 is only able to absorb the light in the wavelength below 500 nm. The increased light harvesting of the composite is supported by the experiment under different filters. The yellow filter (wavelength cut-off < 510

nm) already cuts off the main light absorption of Ag_3VO_4, whereas only some part of $CoTiO_3$ absorption is cut off. It was found that the composite can still absorb light in the range of 500-700 nm according to the UV-vis DRS absorption spectrum. Thus higher activity of composite than that of Ag_3VO_4 is observed when yellow filter used. In addition, the in-situ active species determination is used to verify main important species of each photocatalytic system. The main active species of $CoTiO_3$ system is electron, whereas Ag_3VO_4 and composite reveals that hole is the main active specie in the degradation reaction.