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APPENDICES

Appendix A X-ray Diffractometry of the Bilayer Films

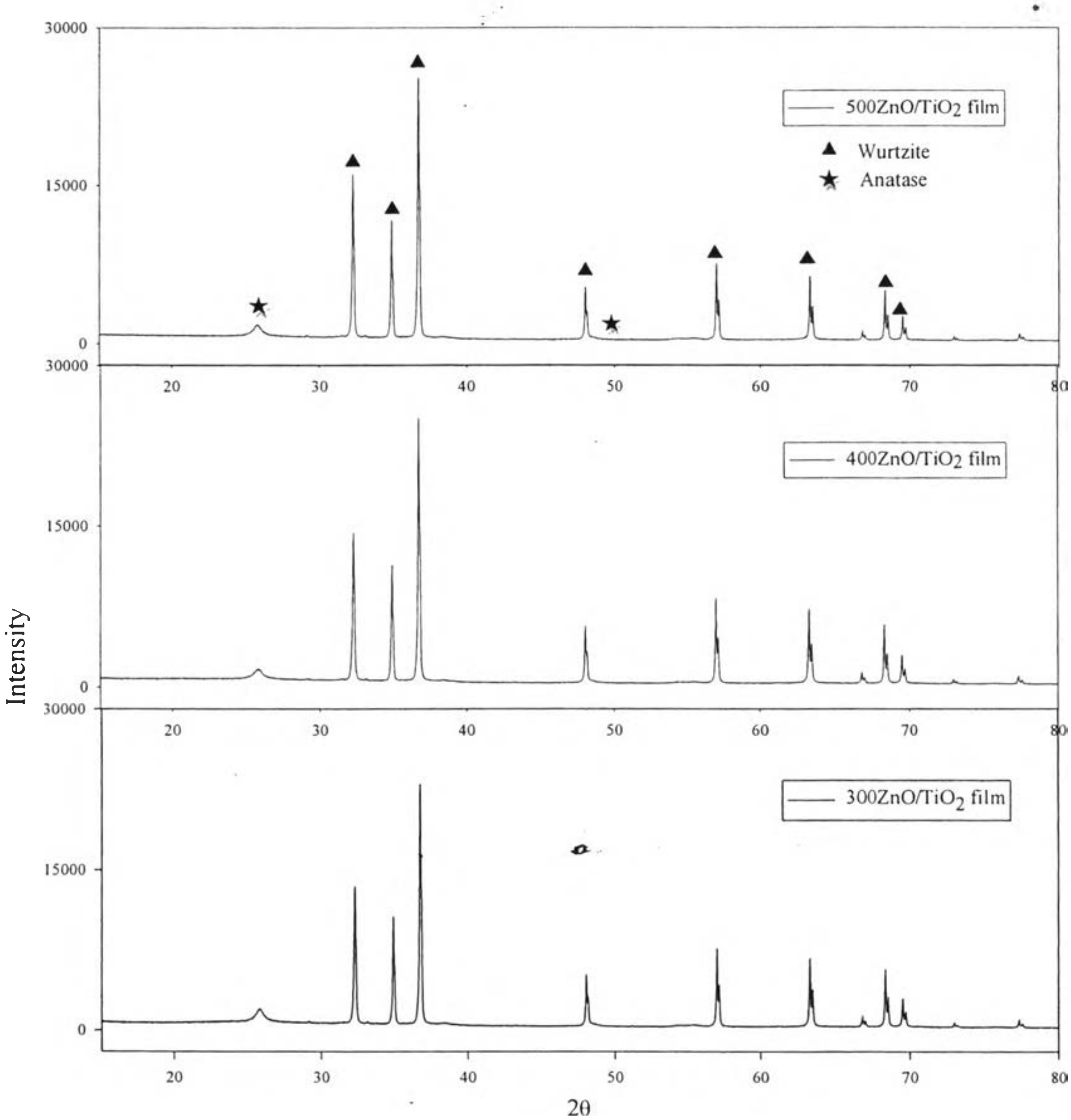

Figure A1 XRD patterns of the ZnO/TiO_2 films at calcination temperature 300 °C, 400 °C and 500 °C, respectively.

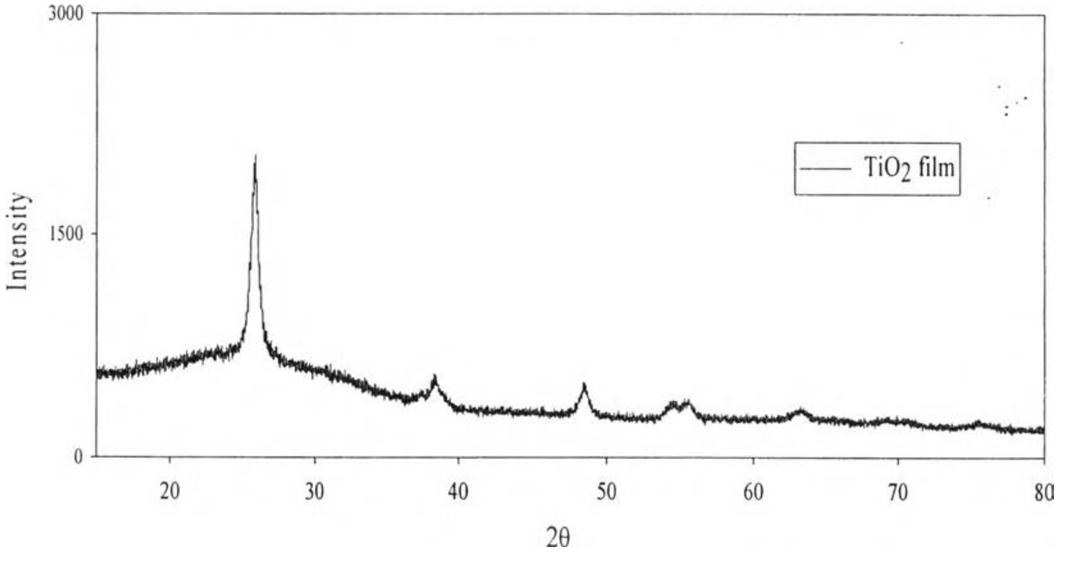

Figure A2 XRD pattern of the TiO_2 films at calcination temperature.

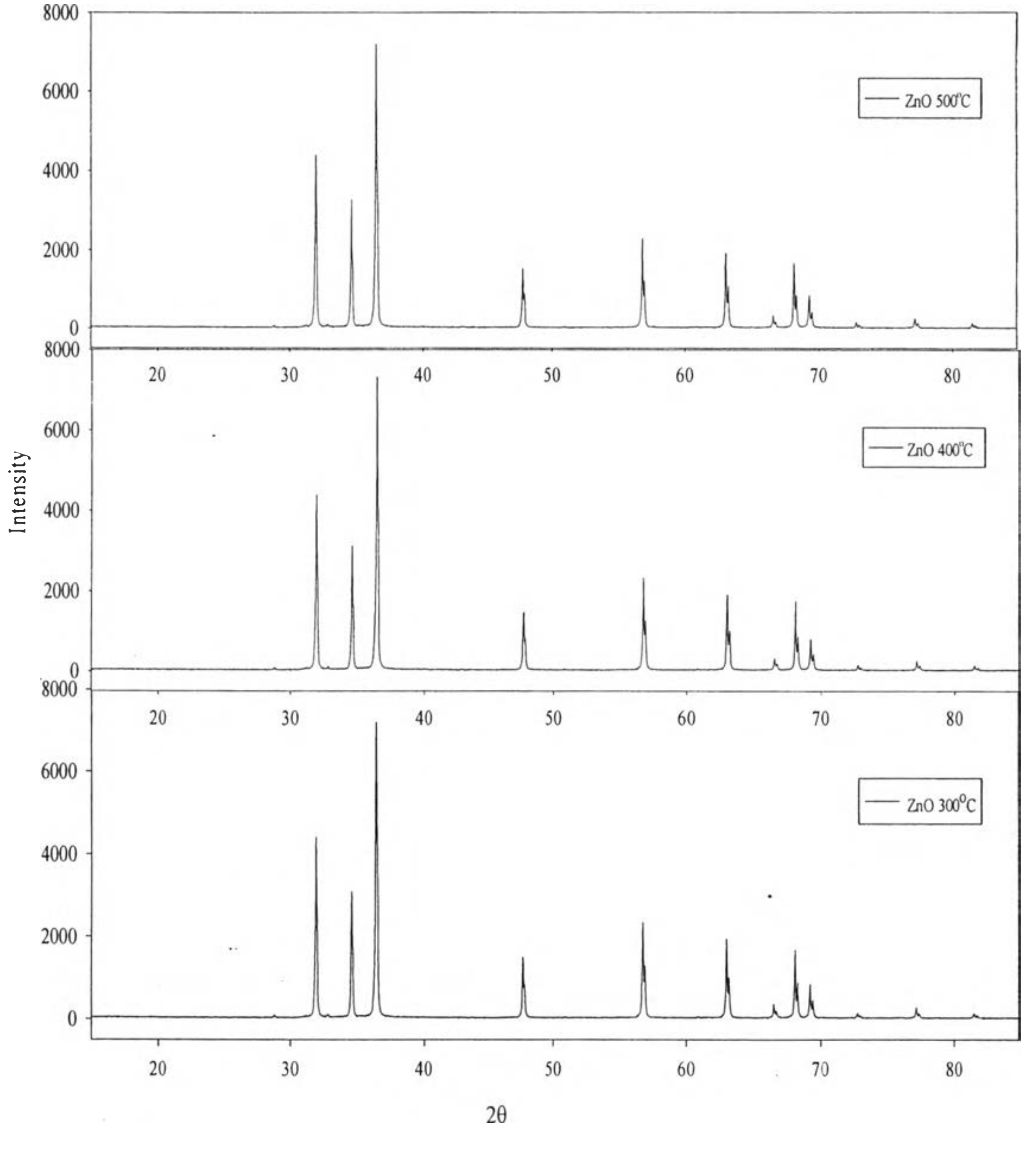

Figure A3 XRD patterns of the ZnO particles at calcination temperature 300 °C, 400 °C and 500 °C, respectively.

To study the structure of the film and ZnO particles, the $300ZnO/TiO_2$, TiO_2 films and ZnO particles were detected by XRD technique (XRD, Rigaku, Smartlab). Figure A1 shows that the XRD patterns of $300ZnO/TiO_2$ compose of wurtzite-ZnO and anatase phase of TiO_2. For the TiO_2 film and ZnO powder in Figure A2, a search match database analysis confirms that the TiO_2 film has the phase composition of anatase. The XRD result in Figure A3 also indicates that the ZnO powder contains the wurtzite phase at 300 °C - 500 °C calcination temperature.

Appendix B Energy Band Gap of ZnO Particles

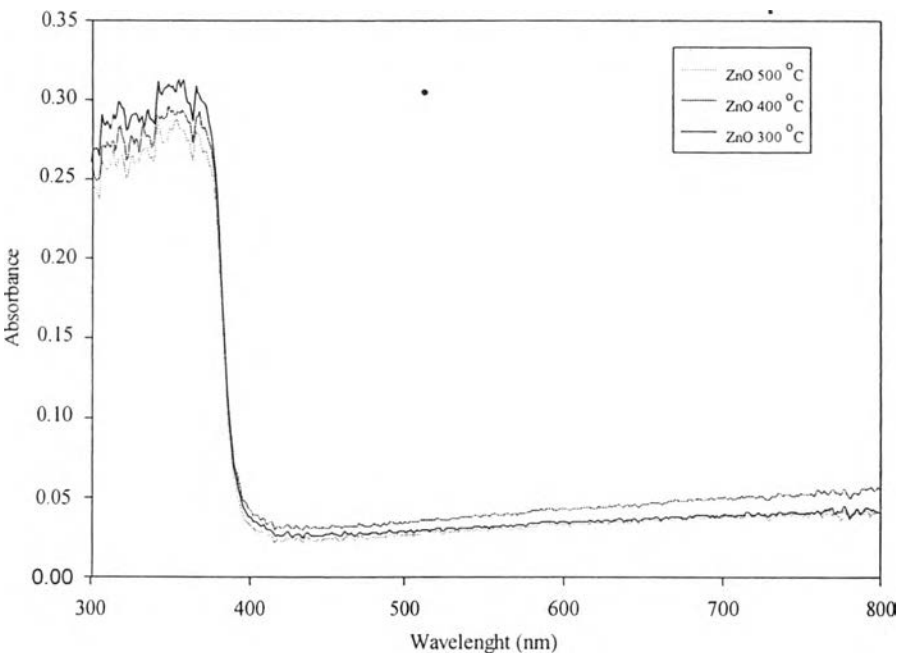

Figure B1 UV-Visible absorption measurement for ZnO

Table B1 The energy band gap from UV-Visible Adsorption

Materials	Calcination temperature (°C)	E_g (eV)
	300	3.21
ZnO	400	3.20
	500	3.18

In order to measure the energy band gap of ZnO particles, the particles were determined from UV adsorption spectrum (UV-Visible 2550) as shown in Figure B1. Table B1 shows that the energy band gap of ZnO particles is decreased when the the calcination temperature of ZnO particles is increased.

Appendix C Calculation for Energy Band Gap of ZnO Particles

From

$$E = \frac{hC}{\lambda}$$

Where

E = Energy band gap (eV)

h = Plank's constant = 6.626 x 10^{-34} J.s

C = Speed of light = 3.0 x 108 m/s

λ = Wavelenght (m)

For example: Solution for ZnO at 300°C

h = 6.626 x 10^{-34} J.s

C = 3.0 x 108 m/s

λ_{300ZnO} = 386 nm

1 eV = 1.6 $\times 10^{19}$ J

Therefore:

$$E = \frac{6.626\times 10^{-34}\ J.s \times 3\times 10^{8} m/s}{386\times 10^{-9} m}$$

E = 5.14 $\times 10^{19}$ J or 3.12 eV

Appendix D Photocatalytic Degradation of Acid Orange 7 without TiO_2 Sol

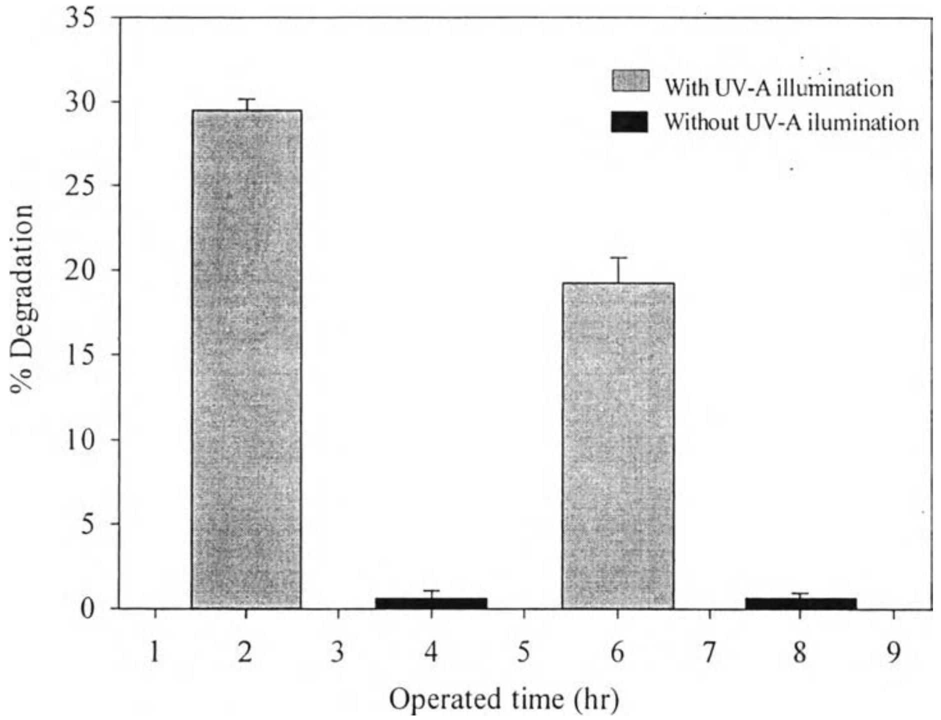

Figure D1 Photocatalytic degradation of acid orange 7 by the 300ZnO/TiO_2 film without using TiO_2 sol.

The photocatalytic reaction was also investigated by the 300ZnO/TiO_2 without TiO_2 sol during catalyst film preparation. The result in Figure D1 shows that the degradation is lower than the 300ZnO/TiO_2 film with TiO_2-sol. It is because the presence of TiO_2-sol helps to contain the ZnO particles on the glass slide substrate, which can enhance the photocatalytic activity of ZnO/TiO_2 film.

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1. Sittiwong, U; Rangsunvigit, P; and Ngaotrakanwiwat, P. (2015, April 21) CO_2 and Photocatalytic Degradaton of Acid orange 7 in the Absence of Light. Proceedings of The 6th Research Symposium on Petroleum, Petrochemicals and Advanced Materials and The 24th PPC Symposium on Petroleum, Petrochemicals, and Polymers, Bangkok, Thailand.