UNIVERSITI TEKNOLOGI MARA

MODIFICATION AND CHARACTERIZATION OF IMMOBILIZED TiO_2/PEG DSAT FOR PHOTODEGRADATION OF MB DYE

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ABSTRACT

A photocatalysis mediated with immobilized titanium dioxide (TiO_2) with polymer has been considered as an interesting subject to degrade organic pollutants. This research is conducted to modify the immobilized TiO_2 using double sided adhesive tape (DSAT) to improve its adhesiveness between TiO_2 and glass as well as to measure its photoactivity and to characterize their properties. Immobilized TiO_2 with polyethylene glycol (PEG) is prepared via brush coating method using Degussa P-25 titania (particle size: 15-20 nm). The films were deposited on DSAT onto glass which acted as a support binder and annealed by a thermal treatment at 100 °C, known as TiO_2/PEG DSAT. The photocatalytic activity of the sample was measured by photodegradation of methylene blue (MB) dye as model pollutant. It was found that washed TiO_2/PEG DSAT film has the highest photoactivity at 0.10% of PEG on 0.30 g of photocatalyst loading named as TP2 sample. From the experimental parameters conducted, it was found that optimum aeration, pH and initial concentration of MB were found at 75 mL/min, pH 11 and 12 ppm respectively. Based on a pseudo first order kinetics, the study showed that the photoactivity of the washed TP2 is 1.8 times faster than TiO_2 suspension. The washed TP2 film turned out smooth, crack-free and doesn't leached out easily due to sufficient amount of TiO_2 to PEG ratio on DSAT. The washing process has influenced the photoactivity of the TP2 sample by 1.6 times faster than unwashed TP2 sample. Results showed that the enlarged number of surface area was 43% higher in the washed TP2 film, where the BET surface area of the photocatalysts: washed TP2, 88 m^2/g; TiO_2 powder, 50 m^2/g). SEM analysis showed that the washed TP2 has larger pore depth than immobilized TiO_2 only. The potentiality of porosity (i.e. larger mesopores) as exhibited by the BET and SEM analysis accounts for numerous active sites that are often associated with high photodegradation rates (pore volume = 0.64 cm^3/g and pore size diameter = 1.71 nm). XRD analysis demonstrated the anatase and rutile phases of the immobilized samples. Furthermore, the XPS spectrum proved that the existence of C=O at 288.7 eV of binding energy in washed TP2 films, where it was not detected in unwashed sample. Since the C=O bond was previously reported as sensitizer for photocatalyst, this has led to a significant photoresponse under normal and visible light irradiation. Additionally, the presence of C=O in the washed TP2 is detected owing to the strong absorption by carbonyl group at 1705 cm^{-1} from the FT-IR spectrum. Through the washing process, the PEG becomes significantly oxidized and the C=O bond is generated. The highest photoluminescence intensity found in the washed TP2 film helped to prove that the C=O species is crucial to enhance the photocatalysis where it acted as an electron injector (sensitizer). Through the application of DSAT, it was found that the films' reusable capacity is up to 30 cycles. Ultimately, the washed immobilized TP2 film is efficient in obtaining a favourable photocatalytic activity performance

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