

SINTESIS NANOKOMPOSIT $\text{Fe}_3\text{O}_4/\text{ZnO}-\text{Cu}$ DAN UJI AKTIVITASNYA SEBAGAI FOTOKATALIS PADA DEGRADASI RHODAMIN B

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INTISARI

Sintesis nanokomposit $\text{Fe}_3\text{O}_4/\text{ZnO}-\text{Cu}$ dan pengujian aktivitasnya sebagai fotokatalis pada degradasi rhodamin B telah dilakukan. Tujuan utama dari penelitian ini yaitu modifikasi material ZnO agar memiliki aktivitas fotokatalitik pada paparan sinar UV dan sinar tampak dan dapat dipisahkan dengan menggunakan magnet eksternal. Penelitian diawali dengan sintesis Fe_3O_4 menggunakan metode sono-kopresipitasi, kemudian sintesis $\text{Fe}_3\text{O}_4/\text{ZnO}$ dengan metode kopresipitasi dan penambahan seng asetat dengan variasi massa. Pelapisan ZnO-Cu pada Fe_3O_4 dilakukan dengan mencampurkan seng asetat ($\text{Zn}(\text{CH}_3\text{COO})_2$) dan tembaga asetat ($\text{Cu}(\text{CH}_3\text{COO})_2$) dengan berbagai variasi konsentrasi ke dalam campuran Fe_3O_4 terdispersi etanol absolut. Material hasil sintesis dikarakterisasi dengan difraktometer sinar-X, spektrometer inframerah, *scanning electron microscope-energy dispersive X*, *transmission electron microscope*, *vibrating sample magnetometer* dan *specular reflectance spectrophotometer*. Uji aktivitas fotokatalitik nanokomposit $\text{Fe}_3\text{O}_4/\text{ZnO}-\text{Cu}$ dilakukan pada proses degradasi rhodamin B dalam reaktor tertutup pada paparan sinar UV dan sinar tampak.

Hasil penelitian menunjukkan bahwa material nanokomposit $\text{Fe}_3\text{O}_4/\text{ZnO}-\text{Cu}$ merupakan material fotokatalis yang responsif terhadap sinar UV dan sinar tampak serta memiliki sifat kemagnetan. Nilai energi celah pita $\text{Fe}_3\text{O}_4/\text{ZnO}-\text{Cu}$ dengan variasi Cu 1, 2, 3, dan 5% berturut-turut sebesar 2,90; 2,94; 2,95; dan 3,02 eV. Material nanokomposit $\text{Fe}_3\text{O}_4/\text{ZnO}$ terdoping Cu 1% memiliki aktivitas fotokatalitik terbaik pada degradasi rhodamin B pada pH 8 dengan massa fotokatalis 20 mg selama 120 menit, dengan hasil degradasi sebesar 86,66 dan 89,41% pada paparan sinar UV dan sinar tampak. Material $\text{Fe}_3\text{O}_4/\text{ZnO}-\text{Cu}$ 1% memiliki sifat magnet sehingga dapat digunakan kembali setelah aktivitas fotokatalitik sebanyak 3 kali tanpa mengalami penurunan fotoaktivitas yang berarti. Studi kinetika reaksi fotodegradasi rhodamin B mengikuti model kinetika Ho dan McKay dengan nilai konstanta laju degradasi sebesar $0,2270 \text{ g mg}^{-1} \text{ menit}^{-1}$ pada paparan sinar UV dan $0,2169 \text{ g mg}^{-1} \text{ menit}^{-1}$ pada paparan sinar tampak.

Kata kunci: fotokatalis, $\text{Fe}_3\text{O}_4/\text{ZnO}-\text{Cu}$, rhodamin B

SYNTHESIS OF $\text{Fe}_3\text{O}_4/\text{ZnO-Cu}$ NANOCOMPOSITE AND ITS ACTIVITY TEST AS PHOTOCATALYST ON THE RHODAMINE B DEGRADATION

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ABSTRACT

Synthesis of $\text{Fe}_3\text{O}_4/\text{ZnO-Cu}$ nanocomposites and its activity tests for degradation of rhodamine B have been investigated. This research aim was to modify ZnO material to enhance its photocatalytic activity under UV and visible light and provide magnetically separable $\text{Fe}_3\text{O}_4/\text{ZnO-Cu}$ nanocomposites material. The research was started with the synthesis of Fe_3O_4 using the sono-coprecipitation method. Synthesis of $\text{Fe}_3\text{O}_4/\text{ZnO}$ was conducted by using the coprecipitation method with several variation of zinc acetate. The coating of ZnO-Cu on Fe_3O_4 was carried out by mixing zinc acetate ($\text{Zn}(\text{CH}_3\text{COO})_2$) with various concentrations of copper acetate ($\text{Cu}(\text{CH}_3\text{COO})_2$) into the absolute ethanol dispersed Fe_3O_4 . The synthesized materials were characterized using X-ray diffractometer, infrared spectrometer, scanning electron microscope-energy dispersive X, transmission electron microscope, vibrating sample magnetometer and specular reflectance spectrophotometer. Photocatalytic activity of $\text{Fe}_3\text{O}_4/\text{ZnO-Cu}$ nanocomposite was examined by the degradation of rhodamine B solution in the closed reactor, under UV and visible light exposure, respectively.

Results showed that $\text{Fe}_3\text{O}_4/\text{ZnO-Cu}$ nanocomposites materials are responsive toward UV and visible light and exhibit good magnetic property. The band gap energy of $\text{Fe}_3\text{O}_4/\text{ZnO-Cu}$ with variations concentration of Cu 1, 2, 3, and 5% were 2.90; 2.94; 2.95; and 3.02 eV, respectively. The $\text{Fe}_3\text{O}_4/\text{ZnO-Cu}$ 1% nanocomposite had the best photocatalytic activity for the degradation of rhodamine-B at a pH of 8, with 20 mg photocatalyst, for 120 minutes irradiation, with the yield of 86.66 and 89.41% under UV and visible light, respectively. The photocatalyst can be reused after photocatalytic process with good performance up to 3 times. Kinetic study of the degradation showed that the reaction followed Ho and McKay with rate constant of 0.2270 and 0.2169 $\text{g mg}^{-1} \text{min}^{-1}$, under UV and visible light exposure, respectively.

Key words: photocatalyst, $\text{Fe}_3\text{O}_4/\text{ZnO-Cu}$, rhodamine B