

PREPARASI NANOKOMPOSIT $\text{Fe}_3\text{O}_4/\text{SiO}_2/\text{TiO}_2\text{-Cu}$ SEBAGAI FOTOKATALIS UNTUK DEGRADASI BIRU METILENA (MB) DI BAWAH RADIASI SINAR TAMPAK

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INTISARI

Preparasi fotokatalis $\text{Fe}_3\text{O}_4/\text{SiO}_2/\text{TiO}_2\text{-Cu}$ dan uji aktivitasnya untuk degradasi MB telah dilakukan. Tujuan penelitian ini adalah untuk mengevaluasi peranan dopan Cu dalam menggeser serapan cahaya fotokatalis menuju daerah sinar tampak serta peranan magnetit (Fe_3O_4) terhadap proses pemisahan fotokatalis dari medium air. Proses preparasi fotokatalis $\text{Fe}_3\text{O}_4/\text{SiO}_2/\text{TiO}_2\text{-Cu}$ dalam penelitian ini meliputi beberapa tahap, *pertama* preparasi Fe_3O_4 dilakukan menggunakan metode sono-kopresipitasi, *kedua*, pelapisan SiO_2 pada Fe_3O_4 dilakukan dengan metode sol gel dengan tetraetilortosilikat (TEOS) sebagai prekursor dan *ketiga*, pelapisan $\text{TiO}_2\text{-Cu}$ pada $\text{Fe}_3\text{O}_4/\text{SiO}_2$ dikerjakan dengan metode sol gel dengan mencampurkan titanium(IV)isopropoksida (TTIP) dan garam CuSO_4 dengan variasi konsentrasi 1, 2, 3% mol/mol dalam campuran heterogen $\text{Fe}_3\text{O}_4/\text{SiO}_2$ terdispersi. Fotokatalis dikarakterisasi dengan SR-UV, XRD, FTIR, TEM, SEM-EDX, VSM dan diuji aktivitasnya untuk mendegradasi zat warna MB pada radiasi sinar tampak.

Berdasarkan hasil XRD, penambahan dopan Cu pada fotokatalis mengakibatkan terjadinya penurunan intensitas puncak anatase. Hasil SR-UV menunjukkan semua material fotokatalis $\text{Fe}_3\text{O}_4/\text{SiO}_2/\text{TiO}_2\text{-Cu}$ variasi konsentrasi Cu mengalami pergeseran serapan ke daerah sinar tampak dengan energi celah pita (E_g) paling kecil dimiliki oleh fotokatalis dengan konsentrasi dopan Cu 1% yaitu 3,03 eV. Ion Cu^{2+} yang masuk ke dalam TiO_2 dibuktikan dengan terdeteksinya Cu pada hasil SEM EDX. Hasil TEM menunjukkan bahwa fotokatalis $\text{Fe}_3\text{O}_4/\text{SiO}_2/\text{TiO}_2\text{-Cu}$ memiliki ukuran 28 nm. Kekuatan magnet fotokatalis yang diperoleh dari hasil karakterisasi VSM sebesar 6,98 emu g^{-1} . Hasil uji degradasi MB menunjukkan material $\text{Fe}_3\text{O}_4/\text{SiO}_2/\text{TiO}_2\text{-Cu}$ 1% memiliki aktivitas paling baik pada radiasi sinar tampak (92,67%). Fotokatalis dapat digunakan berulang sampai dengan 4x pengulangan. Secara keseluruhan, reaksi fotodegradasi MB mengikuti kinetika orde kedua semu Ho dan McKay baik di bawah radiasi sinar tampak maupun sinar UV.

Kata kunci: fotokatalis, $\text{TiO}_2\text{-Cu}$, Fe_3O_4 , biru metilena

PREPARATION OF $\text{Fe}_3\text{O}_4/\text{SiO}_2/\text{TiO}_2\text{-Cu}$ NANOCOMPOSITE AS A PHOTOCATALYST FOR DEGRADATION OF METHYLENE BLUE (MB) UNDER VISIBLE LIGHT RADIATION

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ABSTRACT

Preparation of $\text{Fe}_3\text{O}_4/\text{SiO}_2/\text{TiO}_2\text{-Cu}$ nanocomposite and its testing as a photocatalyst for MB degradation have been investigated. The aims of this research are to evaluate the role of Cu dopant for enhancing visible light absorption of photocatalyst and the role of magnetite (Fe_3O_4) in separating photocatalyst from water. The preparation of $\text{Fe}_3\text{O}_4/\text{SiO}_2/\text{TiO}_2\text{-Cu}$ photocatalyst is following three steps: *first*, Fe_3O_4 has been prepared by sono-coprecipitation method, *second*, coating SiO_2 on the Fe_3O_4 's surface through sol gel method with tetraethylorthosilicate (TEOS) as Si precursor and *third*, coating of $\text{TiO}_2\text{-Cu}$ onto $\text{Fe}_3\text{O}_4/\text{SiO}_2$ has been carried out by sol gel method through mixing titanium(IV)isopropoxide (TTIP) with CuSO_4 at mol ratio 1-3% in the heterogen mixture system of $\text{Fe}_3\text{O}_4/\text{SiO}_2$. The photocatalysts were characterized by using FTIR, XRD, TEM, SEM-EDX, SR-UV and VSM. The photoactivity of materials were also examined for MB degradation under visible light radiation.

Based on XRD results, addition Cu dopan to the photocatalyst caused decreasing of anatase intensity peaks. SR-UV results showed that light absorption of $\text{Fe}_3\text{O}_4/\text{SiO}_2/\text{TiO}_2\text{-Cu}$ photocatalysts with various concentrations of Cu were shifted to visible light region with the smallest band gap energy (E_g) of 3,03 eV which obtained by dopan 1%. Cu^{2+} ion has been successfully doped into TiO_2 that confirmed by the detection of Cu on the SEM EDX. TEM results showed that the particle size of $\text{Fe}_3\text{O}_4/\text{SiO}_2/\text{TiO}_2\text{-Cu}$ was 28 nm. Magnetic moment of photocatalyst obtained by VSM characterization was 6.98 emu g^{-1} . The photocatalyst has the ability to photodegrade MB with precentage yield 92.67 % under visible light radiation. The photocatalyst was also able to be reused as many 4x. The photodegradation of MB by the photocatalyst in this research followed type of Ho and McKay pseudo second orde kinetics under visible light and UV light radiation.

Key words: photocatalyst, $\text{TiO}_2\text{-Cu}$, Fe_3O_4 , methylene blue