

SINTESIS $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-Ag}$ SEBAGAI FOTOKATALIS UNTUK REDUKSI NITROBENZENA

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INTISARI

Sintesis $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-Ag}$ sebagai fotokatalis untuk reduksi nitrobenzena telah dilakukan. Penelitian memiliki tujuan utama yaitu, mengkaji material $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-Ag}$ sebagai fotokatalis yang responsif terhadap sinar tampak dan memiliki sifat kemagnetan serta melakukan uji aktivitasnya untuk reduksi fotokatalitik nitrobenzena. Penelitian diawali dengan sintesis Fe_3O_4 dengan metode sono-kopresipitasi, dilanjutkan sintesis $\text{Fe}_3\text{O}_4/\text{TiO}_2$ dengan prekursor titanium tetraisopropoksida (TTIP) dan Fe_3O_4 dengan metode sol-gel, dan sintesis $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-Ag}$ dengan penambahan logam Ag menggunakan AgNO_3 dan asam askorbat sebagai agen pereduksi ion Ag^+ pada $\text{Fe}_3\text{O}_4/\text{TiO}_2$. Material hasil sintesis dikarakterisasi dengan spektrofotometer inframerah (FTIR), difraktometer sinar-X (XRD), spektrofotometer UV-Visibel, spektrofotometer *Specular Reflectance UV-Visible* (SR UV-Vis), mikroskop transmisi elektron (TEM), *Scanning Electron Microscope-Energy Disperse X-Ray* (SEM-EDX), dan *Vibrating Sample Magnetometer* (VSM). Aktivitas fotokatalis diujikan pada reduksi nitrobenzena pada paparan sinar UV dan sinar tampak. Hasil reduksi dianalisis dengan spektrofotometer UV-Visibel dan GC-MS.

Hasil penelitian menunjukkan bahwa $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-Ag}$ berhasil disintesis berdasarkan spektra FTIR yang mengindikasikan serapan ikatan Ti-O-Ti pada 470-750 cm^{-1} , dan pola difraksi sinar-X dengan puncak karakteristik Fe_3O_4 dan TiO_2 . Material $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-Ag}$ dengan variasi konsentrasi dopan 1, 3, 5 dan 7% memiliki energi celah pita berturut-turut 2,73; 2,72; 2,49 dan 2,63 eV yang menunjukkan bahwa material fotokatalis responsif terhadap sinar tampak. Hasil uji aktivitas fotokatalitik menunjukkan bahwa reduksi fotokatalitik nitrobenzena optimum dicapai menggunakan 20 mg $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-Ag}$ 5% pada 20 mL larutan nitrobenzena dengan konsentrasi 20 ppm, pada pH 7, waktu penyinaran 120 menit, pada suhu ruang. Hasil nitrobenzena yang tereduksi sebesar 93,66% pada paparan sinar tampak dan 17,01% pada paparan sinar UV, dengan anilin sebagai produk utama.

Kata kunci: Fotokatalis, $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-Ag}$, nitrobenzena, reduksi fotokatalitik, sinar tampak

SYNTHESIS OF $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-Ag}$ AS PHOTOCATALYST FOR REDUCTION OF NITROBENZENE

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ABSTRACT

Synthesis of $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-Ag}$ as a photocatalyst for nitrobenzene reduction has been carried out. This research aimed to study $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-Ag}$ material as photocatalyst that responsive to visible light with magnetic properties and test its activity for photocatalytic reduction of nitrobenzene. The research was started by synthesis of Fe_3O_4 through a sono-coprecipitation method, followed by the synthesis of $\text{Fe}_3\text{O}_4/\text{TiO}_2$ using titanium tetraisopropoxide (TTIP) and Fe_3O_4 as precursors through the sol-gel method, and the synthesis of $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-Ag}$ was conducted by doping silver to $\text{Fe}_3\text{O}_4/\text{TiO}_2$ using AgNO_3 and ascorbic acid as a reducing agent for Ag^+ ions. The materials were characterized by Fourier-Transform Infrared spectroscopy (FTIR), X-Ray Diffractometer (XRD), UV-Visible spectrophotometer, Specular Reflectance UV-Visible spectrophotometer (SR UV-Vis), Transmission Electron Microscope (TEM), Scanning Electron Microscope-Energy Disperse X-ray (SEM-EDX), and Vibrating Sample Magnetometer (VSM). Photocatalyst activity was evaluated for the reduction of nitrobenzene under UV and visible light. The reduction yield was analyzed by UV-Vis spectrophotometry and GC-MS.

Results showed that $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-Ag}$ was successfully synthesized based on FTIR spectra which indicated the Ti-O-Ti bond absorption at $470\text{-}750\text{ cm}^{-1}$ and X-ray diffraction pattern with characteristic peaks of Fe_3O_4 and TiO_2 . The $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-Ag}$ materials with various dopant concentrations of 1, 3, 5, and 7% gave bandgap energy of 2.73; 2.72; 2.49, and 2.63 eV, respectively revealed that the photocatalyst materials are responsive to visible light. The photoactivity test results showed that the optimum photocatalytic reduction of nitrobenzene was obtained using 20 mg of $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-Ag}$ 5% photocatalyst with 20 mL of nitrobenzene 20 ppm, at pH 7 and room temperature under 120 minutes irradiation. The reduced nitrobenzene yields were 93.66% and 17.01%, under visible and UV light exposure, respectively, with the aniline as the main product.

Keywords: Photocatalyst, $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-Ag}$, nitrobenzene, photocatalytic reduction, visible light