SINTESIS KOMPOSIT Fe_3O_4/TiO_2-Ag/S DAN AKTIVITAS FOTOKATALITIKNYA TERHADAP DEGRADASI METILEN BIRU

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INTISARI

Sintesis Fe_3O_4/TiO_2-Ag/S untuk degradasi fotokatalitik metilen biru telah dilakukan. Penelitian ini bertujuan untuk mempelajari pengaruh dopan perak dan sulfur dalam modifikasi fotokatalis TiO_2 sehingga lebih responsif pada sinar tampak serta aktivitas fotokatalitik terhadap degradasi metilen biru. Sintesis Fe_3O_4 dilakukan dengan metode kopresipitasi dari prekursor $FeCl_3.6H_2O$ dan $FeSO_4.7H_2O$. Material Fe_3O_4/TiO_2 dan Fe_3O_4/TiO_2-Ag/S disintesis dengan metode sol-gel. Titanium tetraisopropoksida (TTIP) digunakan sebagai prekursor dari TiO_2. Perak nitrat ($AgNO_3$) digunakan sebagai sumber dopan perak dan penggunaan tiourea (CH_4N_2S) sebagai sumber dopan sulfur. Material hasil sintesis dikarakterisasi dengan spektrofotometer FT-IR, difraktometer sinar-X (XRD), spektrofotometer SR UV-Visibel, *Scanning Electron Microscope* dengan *Energy Dispersive X-Ray* (SEM-EDX), *Transmission Electron Microscope* (TEM) dan *Vibrating Sample Magnetometer* (VSM). Aktivitas fotokatalis dilakukan dengan cara degradasi fotokatalitik terhadap metilen biru dalam reaktor tertutup disertai variasi perlakuan yaitu pH, waktu penyinaran, massa fotokatalis, volum metilen biru, penambahan *enhancing agent* (H_2O_2), jenis sinar, dan pengujian penggunaan kembali. Penentuan hasil degradasi fotokatalitik dilakukan dengan menggunakan spektrofotometri UV-Visibel.

Hasil penelitian menunjukkan bahwa sintesis Fe_3O_4/TiO_2-Ag/S berhasil dilakukan. Material Fe_3O_4/TiO_2-Ag/S memiliki sifat kemagnetan dengan nilai saturasi kemagnetan sebesar 5,33 emu/gram. Keberadaan dopan perak dan sulfur menurunkan energi celah pita sehingga responsif terhadap sinar tampak. Aktivitas fotokatalitik optimum terjadi pada Fe_3O_4/TiO_2-Ag/S (2,5%|2,5%) dengan nilai energi celah pita sebesar 2,85 eV. Hasil degradasi fotokatalitik 10 mL metilen biru 5 ppm dengan Fe_3O_4/TiO_2-Ag/S (2,5%|2,5%) mencapai 88,82% di bawah paparan sinar UV dan 99,18% di bawah paparan sinar tampak pada pH 10, waktu paparan selama 120 menit, massa Fe_3O_4/TiO_2-Ag/S sebesar 10 mg, dan penambahan 0,1 mL H_2O_2. Material Fe_3O_4/TiO_2-Ag/S bersifat stabil dalam empat kali penggunaan.

Kata kunci: degradasi, Fe_3O_4/TiO_2-Ag/S, dopan, metilen biru

SYNTHESIS OF Fe_3O_4/TiO_2-Ag/S COMPOSITE AND ITS PHOTOCATALYTIC ACTIVITY TOWARDS DEGRADATION OF METHYLENE BLUE

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ABSTRACT

Synthesis of Fe_3O_4/TiO_2-Ag/S for degradation of methylene blue has been carried out. The purpose of this research was to study the effect of silver and sulphur dopants into TiO_2 modification as photocatalyst to be more responsive on visible light and also its photocatalytic activity towards degradation of methylene blue. The synthesis of Fe_3O_4 was initiated through coprecipitation method from $FeCl_3.6H_2O$ and $FeSO_4.7H_2O$ as the precursors. Both Fe_3O_4/TiO_2 dan Fe_3O_4/TiO_2-Ag/S were synthesized by using sol-gel method. Titanium tetraisopropoxide (TTIP) was used as the precursor of TiO_2. Silver nitrate ($AgNO_3$) was used as silver dopant source and the usage of thiourea (CH_4N_2S) as sulphur dopant source. The synthesized materials were characterized by using FT-IR spectrophotometer, X-Ray Difractometer (XRD), SR UV-Visible spectrophotometer, Scanning Electron Microscope with Energy Dispersive X-Ray (SEM-EDX), Transmission Electron Microscope (TEM) and Vibrating Sample Magnetometer (VSM). The activity of photocatalysts were performed by photocatalytic degradation towards methylene blue inside a closed photoreactor with several variations which are pH, irradiation time, photocatalyst mass, methylene blue volume, addition of enhancing agent (H_2O_2), types of light, and reusability test.

The result showed that Fe_3O_4/TiO_2-Ag/S was synthesized successfully. The Fe_3O_4/TiO_2-Ag/S material showed magnetic properties as the magnetic saturation value was 5,33 emu/gram. The presence of silver and sulphur dopants lower the band gap and tended to be responsive towards visible light exposure. The optimum photocatalytic activity was obtained on Fe_3O_4/TiO_2-Ag/S (2,5%|2,5%) with the band gap value was 2,85 eV. The photocatalytic degradation result of 10 mL methylene blue 5 ppm reached 88,82% under UV light exposure and 99,18% under visible light exposure at pH 7, 120 minutes irradiation time, 10 mg of Fe_3O_4/TiO_2-Ag/S, and addition of 0,1 mL H_2O_2. The Fe_3O_4/TiO_2-Ag/S was stable under four times usage.

Keywords: degradation, Fe_3O_4/TiO_2-Ag/S, dopant, methylene blue