SINTESIS NANOKOMPOSIT N-Co-*CODOPED* TiO_2 TERIMOBILISASI PADA ZrO_2 SEBAGAI FOTOKATALIS UNTUK FOTODEGRADASI *MALACHITE GREEN* DI BAWAH IRADIASI SINAR TAMPAK

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INTISARI

Sintesis Nanokomposit N-Co-*Codoped* TiO_2 Terimobilisasi pada ZrO_2 sebagai Fotokatalis untuk Fotodegradasi *Malachite Green* di bawah Iradiasi Sinar Tampak telah dilakukan. Penelitian ini bertujuan untuk mempelajari pengaruh variasi konsentrasi *doping* logam Co dan temperatur kalsinasi terhadap karakteristik nanokomposit N-Co-*Codoped* TiO_2 terimobilisasi pada ZrO_2 (N-Co-TZ) untuk mendegradasi larutan *malachite green* di bawah iradiasi sinar tampak. Sintesis N-Co-TZ dengan metode sol-gel diawali dengan melarutkan titanium tetraisopropoksida (TTIP) dalam etanol absolut yang kemudian direaksikan dengan ZrO_2, nitrogen dari urea dengan konsentrasi 10% (b/b) (N/Ti) dan $CoCl_2 \bullet 6H_2O$ dengan konsentrasi 0, 1, 3, 5, 7 dan 9% (b/b) (Co/Ti). Nanokomposit N-Co-TZ (5% Co) di kalsinasi pada variasi suhu 500, 700 dan 900 °C. Komposit dikarakterisasi menggunakan FTIR, XRD, SEM-EDX dan SRUV. Fotodegradasi larutan *malachite green* 4 ppm dilakukan pada variasi waktu iradiasi 0, 20, 40, 60, 80, 100 dan 120 menit di bawah sinar tampak. Konsentrasi *malachite green* setelah fotodegradasi diukur menggunakan spektrofotometer UV-Vis pada panjang gelombang 617 nm.

Hasil yang didapatkan menunjukkan spektra FTIR komposit N-Co-TZ terdapat *overlapping* antara vibrasi Zr–O dan Ti–O–Ti pada bilangan gelombang 500–650 cm^{-1}. Analisis difraktogram komposit tersebut mengindikasikan terbentuknya struktur kristal *anatase* dan monoklinik pada temperatur 500 °C. Setelah proses kalsinasi dilakukan pada temperatur 700 dan 900 °C struktur *rutile* terbentuk. Morfologi permukaan komposit N-Co-TZ berbentuk bulat, kasar dan homogen berdasarkan pengamatan dari hasil citra SEM. Analisis EDX membuktikan keberadaan unsur utama Zr, O, Ti, N dan Co pada fotokatalis yang disintesis. Analisis tepi serapan spektra SRUV memberikan energi celah pita sebesar 2,65 eV dan panjang gelombang 469 nm, sehingga tepi serapan komposit N-Co-TZ aktif di daerah serapan sinar tampak. Komposit N-Co-TZ pada temperatur kalsinasi 500 °C mampu mendegradasi larutan *malachite green* di bawah iradiasi sinar tampak hingga 74,73% dengan tetapan laju reaksi sebesar 0,0119 $menit^{-1}$.

Kata kunci: fotodegradasi, komposit, laju reaksi, *malachite green*, sinar tampak

SYNTHESIS OF N-Co-CODOPED TiO_2 NANOCOMPOSITE IMMOBILIZED ON ZrO_2 AS A PHOTOCATALYST FOR PHOTODEGRADATION OF MALACHITE GREEN UNDER VISIBLE LIGHT IRRADIATION

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ABSTRACT

Synthesis of N-Co-Codoped TiO_2 Nanocomposite Immobilized on ZrO_2 as a Photocatalyst for Photodegradation of Malachite Green Under Visible Light Irradiation has done. This research aims to study the effect of Co metal doping concentration and calcination temperature variation on the character properties of N-Co-Codoped TiO_2 nanocomposite immobilized on ZrO_2 (N-Co-TZ) in degrading *malachite green* solution under visible light irradiation. Synthesis of N-Co-TZ by sol gel method started with dissolving titanium tetraisopropoxide (TTIP) in absolute ethanol, then reacted with ZrO_2, nitrogen from urea 10% (w/w) (N/Ti) and $CoCl_2 \bullet 6H_2O$ with various concentration of 0, 1, 3, 5, 7 and 9% (w/w) (Co/Ti). The variation concentration of $CoCl_2 \bullet 6H_2O$ was calcined at 500 °C. Nanocomposite N-Co-TZ (5% Co) calcined with various calcination temperatures at 500, 700 and 900 °C. The composites were characterized using FTIR, XRD, SEM-EDX and SRUV. Photodegradation of 4 ppm malachite green solution was carried out at various irradiation times of 0, 20, 40, 60, 80, 100 and 120 minutes under visible light. The concentration of malachite green after photodegradation was measured using a UV-Vis spectrophotometer at a wavelength of 617 nm.

The results showed that the FTIR spectra of N-Co-TZ composite exhibited overlapping vibration of Zr−O and Ti−O−Ti in the wave numbers ranging from of 500−650 cm^{-1}. The diffractogram analysis of the composite indicate the presence of anatase and monoclinic crystal structure is observed at 500 °C. After calcination at temperature 700 and 900 °C structure of photocatalyst was rutile. The surface morphology of N-Co-TZ composite is round, spherical, and homogeneous based on observation from SEM images. EDX analysis revealed the presence of the main elements Zr, O, Ti, N, and Co in the synthezised photocatalyst. The absorption edge analysis of SRUV spectra resulted in a band gap energy of 2.65 eV and a wavelength of 469 nm, so the absorption edge of the N-Co-TZ composite can be active in the visible light region. The N-Co-TZ composite at a calcination temperature of 500 °C was able to degrade malachite green solution under visible light irradiation up to 74.73% with a constant reaction rate of 0.0119 $minute^{-1}$.

Keywords: composite, malachite green, photodegradation, reaction rate, visible light