SINTESIS ZIRKONIUM TITANAT *CODOPED* NIKEL-NITROGEN (Ni-N-*CODOPED* $ZrTiO_4$) SEBAGAI FOTOKATALIS RESPONSIF SINAR TAMPAK PADA FOTODEGRADASI BIRU METILEN

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INTISARI

Material fotokatalis zirkonium titanat *codoped* nikel-nitrogen telah berhasil disintesis menggunakan metode sol-gel. Tujuan dari penelitian ini adalah mempelajari pengaruh konsentrasi dopan nikel dan suhu kalsinasi terhadap karakteristik fotokatalis serta aktivitasnya dalam proses fotodegradasi biru metilen. Titanium Tetraisopropoksida (TTIP) dilarutkan dalam etanol absolut untuk membuat prekursor Ti. Suspensi zirkonia (ZrO_2) yang mengandung 10% Nitrogen (N) dan Nikel (Ni) dengan konsentrasi 2, 4, 6, 8, dan 10% ditambahkan ke dalam prekursor Ti. Kalsinasi dilakukan pada suhu 500, 700 dan 900 ℃ selama 4 jam. Komposit yang terbentuk kemudian dikarakterisasi dengan menggunakan *X-Ray Diffractometer* (XRD), Fourier *Transform Infrared Spectrophotometer* (FTIR), *Specular Reflectance UV-Visible* (SR-UV) dan *Scanning Electron Microscopy* dengan *Energy Dispersive X-Ray* (SEM-EDX). Uji aktivitas fotokatalitik fotokatalis menggunakan larutan biru metilen dengan konsentrasi 4 mg/L dengan variasi waktu penyinaran 15, 30, 45, 60, 75, 90, 105 dan 120 menit di bawah iradiasi sinar tampak. Konsentrasi larutan biru metilen setelah fotodegradasi ditentukan dengan mengukur absorbansi menggunakan spektrofotometer UV-Vis pada panjang gelombang 664 nm.

Karakterisasi XRD menunjukkan adanya penambahan dopan nikel mampu menghambat pertumbuhan *anatase* yang berlebih dalam $ZrTiO_4$. Fase tetragonal teramati pada semua variasi suhu kalsinasi. ZrO_2 sebagai *supporting material* mampu meningkatkan kestabilan termal Ni-N-*codoped* $ZrTiO_4$. Spektra FTIR menunjukkan pita vibrasi disekitar 1095 cm^{-1} pada $ZrTiO_4$ terdoping nikel dan nitrogen yang merupakan ikatan Ti–O–Ni atau O–Ti–N. Analisis SEM menunjukkan morfologi Ni-N-*codoped* $ZrTiO_4$ memiliki bentuk bulat (*spherical)* dan homogen. Hasil spektrum EDX membuktikan adanya unsur utama Zr, Ti, O, Ni dan N pada fotokatalis yang disintesis. Hasil analisis SRUV menunjukkan bahwa penambahan dopan Ni dan N dapat menggeser tepi serapan fotokatalis ke daerah sinar tampak dengan panjang gelombang 442 nm dengan energi celah pita sebesar 2,81 eV. Material fotokatalis hasil sintesis mampu mendegradasi larutan biru metilen hingga di bawah iradiasi sinar tampak.

Kata kunci: Biru metilen, doping, fotodegradasi, Ni-N-*codoped* $ZrTiO_4$

SYNTHESIS OF NICKEL-NITROGEN CODOPED ZIRCONIUM TITANATE (Ni-N-CODOPED $ZrTiO_4$) AS VISIBLE LIGHT RESPONSIVE PHOTOCATALYST ON METHYLENE BLUE PHOTODEGRADATION

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ABSTRACT

Nickel-nitrogen codoped zirconium titanate photocatalyst material has been successfully synthesized using sol-gel method. The purpose of this research is to study the effect of nickel dopant concentration variation and calcination temperature on photocatalyst characteristics and its activity in the methylene blue photodegradation process. The synthesis process begins by mixing Titanium Tetraisopropoxide (TTIP) with absolute ethanol to produce Ti precursor. Zirconia suspension (ZrO_2) containing 10% Nitrogen (N) and Nickel (Ni) with concentration variations of 2, 4, 6, 8, and 10% were added to the Ti precursor until a suspension was formed. Calcination was performed at 500, 700 and 900 ℃ for 4 hours. The composites were then characterized using X-Ray Diffractometer (XRD), Fourier Transform Infrared Spectrophotometer (FTIR), Specular Reflectance UV-Visible (SR-UV) and Scanning Electron Microscopy with Energy Dispersive X-Ray (SEM-EDX). The Photocatalytic activity of the photocatalyst was tested by using methylene blue solution with a concentration of 4 mg/L at various irradiation times of 15, 30, 45, 60, 75, 90, 105, and 120 minutes under visible light irradiation. The concentration of methylene blue solution after photodegradation was determined by measuring the absorbance using a UV-Vis spectrophotometer at a wavelength of 664 nm.

XRD characterization showed that the addition of nickel dopant can inhibit the excessive growth of anatase phase in $ZrTiO_4$. Tetragonal phase was observed in all calcination temperature variations. ZrO_2 as a supporting material is able to increase the thermal stability of Ni-N-codoped $ZrTiO_4$. FTIR spectra showed vibration bands around 1095 cm^{-1} in nickel and nitrogen-codoped $ZrTiO_4$ which is a Ti–O–Ni or O–Ti–N bond. SEM analysis showed the morphology of Ni-N-codoped $ZrTiO_4$ is spherical and homogeneous. The EDX spectrum confirmed the presence of Zr, Ti, O, Ni, and N as the main elements in the synthesized photocatalyst. SRUV analysis results showed that the addition of Ni and N dopants can shift the absorption edge of the photocatalyst to the visible light region with a wavelength of 442 nm with a band gap energy of 2.81 eV. The synthesized photocatalyst material can degrade methylene blue solution under visible light irradiation.

Keywords: Methylene blue, doping, photodegradation, Ni-N-codoped $ZrTiO_4$