SINTESIS ZIRKONIUM TITANAT TERDOPING SENG-NITROGEN (Zn-N-*CODOPED* $ZrTiO_4$) SEBAGAI FOTOKATALIS UNTUK FOTODEGRADASI FENOL DENGAN IRADIASI SINAR TAMPAK

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INTISARI

Sintesis fotokatalis zirkonium titanat terdoping seng-nitrogen (Zn-N-*codoped* $ZrTiO_4$) dengan metode sol-gel berhasil dilakukan. Penelitian ini bertujuan untuk mempelajari pengaruh variasi konsentrasi Zn dan temperatur kalsinasi terhadap karakteristik komposit dalam mendegradasi larutan fenol (Ph) pada iradiasi sinar tampak. Komposit disintesis melalui metode sol-gel dengan melarutkan TTIP ke dalam etanol. Suspensi ZrO_2 yang mengandung nitrogen (N) 10% dan variasi dopan logam seng (Zn) konsentrasi 1, 3, 5, 7, dan 9% dicampurkan ke dalam campuran TTIP dan etanol. Padatan dikalsinasi pada temperatur 500, 700, dan 900 °C. Komposit dikarakterisasi dengan FTIR, XRD, SEM-EDX, dan SR-UV. Fotodegradasi larutan Ph 10 mg/L dilakukan pada variasi waktu iradiasi 0, 15, 30, 45, 60, 75, 90, 105, dan 120 menit. Konsentrasi larutan Ph setelah fotodegradasi ditentukan melalui pengukuran absorbansi melalui spektrofotometer UV-Vis pada panjang gelombang 269 nm.

Hasil penelitian menunjukan bahwa spektra FTIR komposit Zn-N-*codoped* $ZrTiO_4$ pada bilangan gelombang 400-700 cm^{-1} terdapat *overlapping* antara vibrasi Zr-O dan Ti-O-Ti. Difraktogram komposit pada temperatur kalsinasi 500 °C menunjukan struktur kristal monoklinik dan anatas. Struktur kristal komposit pada temperatur kalsinasi 700 dan 900 °C mulai terbentuk struktur rutil. Hasil citra EDX permukaan komposit Zn-N-*codoped* $ZrTiO_4$ menunjukan morfologi yang berbentuk bulat dan homogen. Hasil EDX komposit menunjukan keberadaan unsur utama Zr, Ti, O, Zn, dan N. Spektra SR-UV menunjukan dengan penambahan dopan ganda Zn dan N dapat menggeser tepi serapan fotokatalis ke daerah sinar tampak pada panjang gelombang 405 nm dengan energi celah pita sebesar 3,06 eV. Komposit Zn-N-*codoped* $ZrTiO_4$ dengan temperatur kalsinasi 500 °C dapat mendegradasi larutan fenol di bawah iradiasi sinar tampak hingga 51,96% dengan konstanta laju reaksi sebesar 0,0084 $menit^{-1}$.

Kata kunci: fenol, fotodegradasi, komposit, sinar tampak, Zn-N-*codoped* $ZrTiO_4$.

SYNTHESIS OF ZINC-NITROGEN CODOPED ZIRCOIUM TITANATE (Zn-N-CODOPED $ZrTiO_4$) AS A PHOTOCATALYST FOR PHOTODEGRADATION OF PHENOL UNDER VISIBLE LIGHT IRRADIATION

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ABSTRACT

The synthesis of zinc-nitrogen codoped zirconium titanate photocatalyst (Zn-N-codoped $ZrTiO_4$) via the sol-gel method has been successfully conducted. This study aims to investigate the influence of Zn concentration variations and calcination temperature on the characteristics of the composite in degrading phenol (Ph) solution under visible light irradiation. The composite was synthesized by the sol-gel method by dissolving TTIP in ethanol. ZrO_2 suspension containing 10% nitrogen (N) and various concentrations of zinc metal dopant (Zn) at 1, 3, 5, 7, and 9% were mixed into the TTIP and ethanol mixture. The solids were calcined at temperatures 500, 700, and 900 °C. The composite was characterized by FTIR, XRD, SEM-EDX, and SR-UV. Photodegradation of 10 mg/L Ph solution was performed at various irradiation times of 0, 15, 30, 45, 60, 75, 90, 105, and 120 minutes. The concentration of Ph solution after photodegradation was determined by measuring absorbance using a UV-Vis spectrophotometer at a wavelength of 269 nm.

The research results show that the FTIR spectra of Zn-N-codoped $ZrTiO_4$ composite in the wavenumber range of 400-700 cm^{-1} exhibit overlapping between Zr-O and Ti-O-Ti vibrations. XRD patterns of the composite at a calcination temperature of 500 °C indicate a monoclinic and anatase crystal structure. The crystal structure of the composite at calcination temperatures of 700 and 900 °C begins to form a rutile structure. Surface EDX images of the Zn-N-codoped $ZrTiO_4$ composite show a spherical and homogeneous morphology. EDX results of the composite indicate the presence of main elements Zr, Ti, O, Zn, and N. SR-UV spectra show that the addition of dual dopants Zn and N can shift the absorption edge of the photocatalyst to the visible light region at a wavelength of 405 nm with a bandgap energy of 3.06 eV. The Zn-N-codoped $ZrTiO_4$ composite with a calcination temperature of 500 °C can degrade phenol solution under visible light irradiation up to 51.96% with a reaction rate constant of 0.0084 min^{-1}.

Keywords: composite, phenol, photodegradation, visible light, Zn-N-codoped $ZrTiO_4$..