

SINTESIS ZIRKONIUM TITANAT TERDOPING TEMBAGA-NITROGEN (Cu-N-CODOPED ZrTiO₄) SEBAGAI FOTOKATALIS UNTUK FOTODEGRADASI METILEN BIRU DI BAWAH IRADIASI SINAR TAMPAK

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INTISARI

Sintesis komposit zirkonium titanat terdoping tembaga-nitrogen (Cu-N-codoped ZrTiO₄) sebagai fotokatalis telah berhasil dilakukan dengan metode sol gel. Tujuan penelitian ini adalah mempelajari pengaruh variasi konsentrasi tembaga dan temperatur kalsinasi terhadap karakteristik komposit dalam mendegradasi larutan metilen biru (MB) di bawah iradiasi sinar tampak.

Proses sintesis diawali dengan melarutkan TTIP ke dalam etanol. Suspensi zirkonia (ZrO₂) yang mengandung 10,0% nitrogen (N) dan tembaga (Cu) dengan konsentrasi 2,0%, 4,0%, 6,0%, 8,0%, dan 10,0% dicampurkan ke dalam larutan TTIP. Kalsinasi dilakukan pada temperatur 500, 700, dan 900 °C. Komposit dikarakterisasi menggunakan FTIR, XRD, SEM-EDX, XRF, dan SRUV. Fotodegradasi larutan MB 4 mg/L dilakukan pada waktu iradiasi 15, 30, 45, 60, 75, 90, 105, dan 120 menit di bawah sinar tampak. Konsentrasi larutan MB setelah fotodegradasi ditentukan melalui pengukuran absorbansi menggunakan spektrofotometer Vis (visible) pada panjang gelombang 664 nm.

Hasil penelitian menunjukkan bahwa pada spektra FTIR komposit Cu-N-codoped ZrTiO₄ terdapat *overlapping* antara vibrasi Zr–O dan Ti–O–Ti pada bilangan gelombang 500-650 cm⁻¹. Struktur kristal komposit pada temperatur kalsinasi 500 °C adalah monoklinik dan anatas. Struktur rutil muncul pada temperatur kalsinasi 700 dan 900 °C. Analisis SEM menunjukkan bahwa morfologi komposit berbentuk bulat dan homogen. Hasil spektrum EDX dan XRF membuktikan adanya unsur utama Zr, O, Ti, Cu dan N pada material yang disintesis. Penambahan dopan Cu dan N berpengaruh pada pergeseran tepi serapan ke daerah sinar tampak yaitu pada panjang gelombang 468 nm dengan nilai energi celah pita sebesar 2,65 eV. Komposit mampu mendegradasi larutan MB di bawah iradiasi sinar tampak hingga 83,05% dengan laju reaksi sebesar 0,0148 ppm/menit. Fotodegradasi larutan MB di bawah iradiasi sinar UV dilakukan sebagai pembandingan dan diperoleh persentase fotodegradasi sebesar 93,28% dengan laju reaksi sebesar 0,0225 ppm/menit.

Kata kunci: Fotodegradasi, metilen biru, sinar tampak, tembaga-nitrogen, ZrTiO₄.

SYNTHESIS OF COPPER-NITROGEN CODOPED ZIRCONIUM TITANATE (Cu-N-CODOPED ZrTiO₄) AS A PHOTOCATALYST FOR PHOTODEGRADATION OF METHYLENE BLUE UNDER VISIBLE LIGHT IRRADIATION

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ABSTRACT

Synthesis of nitrogen and copper codoped zirconium titanate (Cu-N-codoped ZrTiO₄) photocatalyst was conducted by sol gel method. The purpose of this research was to investigate the effect of varied copper concentration and calcination temperature on the characteristics of the composite for methylen blue (MB) degradation under visible light irradiation.

The synthesis began by dissolved TTIP in ethanol. The suspension of zirconia (ZrO₂) containing 10,0% nitrogen (N) and copper (Cu) with concentrations of 2,0%, 4,0%, 6,0%, 8,0%, and 10,0% mixed into the TTIP solution. The calcination was performed at temperatures of 500, 700, and 900 °C. Composites were characterized using FTIR, XRD, SEM-EDX, XRF and SRUV. Photodegradation of 4 mg/L MB solution was conducted at 15, 30, 45, 60, 75, 90, 105, and 120 minutes under visible light irradiation. The concentration of MB solution after photodegradation was determined by measuring absorbance using Vis spectrophotometer at the wavelength of 664 nm.

The result showed at the FTIR spectra of Cu-N-codoped ZrTiO₄ composite there was overlap between Zr–O and Ti–O–Ti vibrations at 500-650 cm⁻¹. The crystal structure of the composite at 500 °C is monoclinic and anatase. The rutile structure appears at the temperatures of 700 and 900 °C. Images SEM of the composites are round and uniform. The results of the EDX and XRF spectra proved the presence of the main elements of Zr, O, Ti, Cu and N in material. The addition of Cu and N as dopants have an effect on the shift of the absorption edge to the visible light region, at a wavelength of 468 nm with a bandgap energy of 2.65 eV. The synthesized material was able to degrade 4 mg/L of MB solution under visible light irradiation up to 83.05% with a reaction rate of 0.0148 ppm/minute. Photodegradation of MB solution under UV light irradiation was carried out as a comparison and a photodegradation percentage of 93.28% was obtained with a reaction rate of 0.0225 ppm/minute.

Key words : Copper-nitrogen, methylene blue, photodegradation, visible light, ZrTiO₄.